

The Authoritative Magazine About High Fidelity

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*at  
Carnegie  
Hall*

# AUDIO

JULY  
1970

60¢

**QUADRAPHONIC SYSTEM**  
**A NEW**  
**FM TUNER ALIGNMENT**

1970  
*Consumer Electronics  
Show*





# POWER and purpose are implicit in its every distinctive line...



Never before has there been a receiver like the 387.

Power and purpose are implicit in its every distinctive line . . .

from its bold new high-visibility dial face to the sweep of its comprehensive control panel.

And just wait until you experience the 387's effortless performance! A new kind of receiver power is yours to command — instantaneous, undistorted, unmatched for flexibility and responsiveness.

Inside, the 387 justifies its advanced exterior. Here are tomorrow's electronics . . .

Integrated Circuits, Field Effect Transistors, solderless connections, and electronic safeguard systems to keep the 387's 270 Watts of power totally usable under all conditions.

Decades of manufacturing experience and engineering skill have gone into the 387. But to really appreciate how its designers have totally rejected the ordinary, you must see it and hear it.

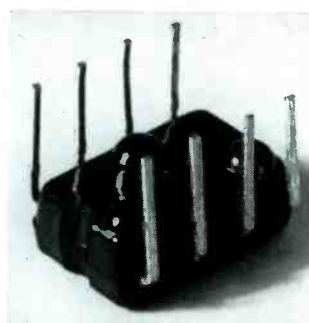
## SCOTT 387 AM/FM STEREO RECEIVER



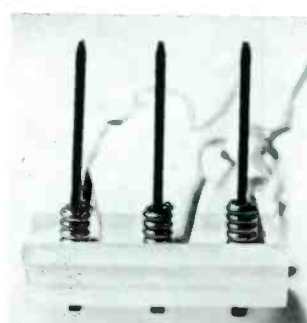
**Computer-activated "Perfectune" light:** Perfectune computer decides when you're tuned for the best reception and lowest distortion, then snaps on the Perfectune light.



**New Modutron Circuit Board Exchange Policy:** Takes over after your warranty expires; insures quick, inexpensive replacement of any plug-in printed circuit board for as long as you own your Scott unit.



**Ultra-reliable Integrated Circuits:** Seven IC's are included in the 387 . . . totalling 91 transistors, 28 diodes, and 109 resistors.



**New solderless connection techniques:** Tension-wrapped terminal connections plus plug-in circuit modules result in the kind of reliability associated with aerospace applications.

### 387 SPECIFICATIONS

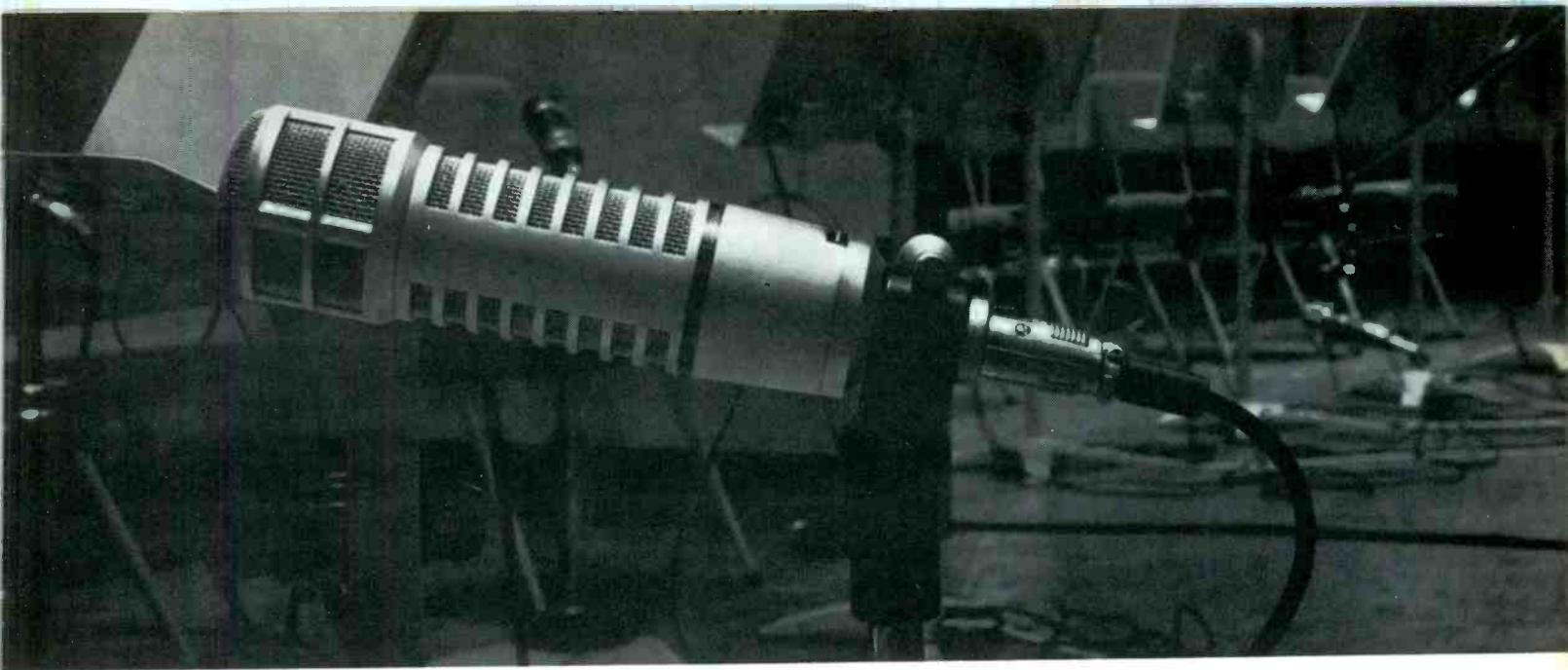
**AMPLIFIER SECTION:** Total power ( $\pm 1$  dB) 270 Watts @ 4 Ohms; IHF music power, 220 Watts @ 4 Ohms; 140 Watts @ 8 Ohms; Continuous output, with one channel driven, 100/100 Watts @ 4 Ohms; 63/63 Watts @ 8 Ohms; Continuous output, with both channels driven, 85/85 Watts @ 4 Ohms; 55/55 Watts @ 8 Ohms; Harmonic distortion, 0.5% at rated output; IHF power bandwidth, 10 Hz — 38 kHz; Hum and noise, phone, —70 dB. **TUNER SECTION:** (FM); Usable sensitivity (IHF), 1.9  $\mu$ V; Stereo separation, 40 dB; Capture ratio, 2.5 dB; Signal/Noise ratio, 65 dB; Cross modulation rejection, 80 dB; Selectivity, 42 dB. **TUNER SECTION:** (AM); Sensitivity (IHF), 4  $\mu$ V @ 600 kHz; Selectivity (IHF), 32 dB.

**Price:** \$449.95 Accessory case, extra.

Prices and specifications subject to change without notice.

## SCOTT®

For detailed specifications, write:  
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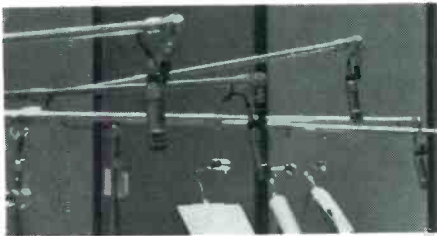


# How good is the new Electro-Voice RE20 studio dynamic microphone?

## Here's proof from the new scoring stage at Glen Glenn.

**Ey** The fine reputation of Glen Glenn Sound Company rests on their knowledge of sound... their ability to turn a full symphony orchestra into a perfect sound track for TV, the movies, or a new album. And their desire to be first with the finest.

So for their new scoring Studio M, Glen Glenn engineers asked to see the latest products in every category... tape, film, electronics, and — of course — microphones. Especially a new E-V dynamic cardioid microphone which they had seen in prototype form earlier.



Glen Glenn put the RE20 to the test. Including days of studio experiments and actual sessions that pitted the RE20 against every type of musical instrument. Plus a searching critique by the musicians themselves. The RE20 passed every test with flying colors.

As a result, when Studio M was completed, RE20's were on the booms... almost four dozen of them from our first production run.



Since then, Glen Glenn has scheduled a number of major recordings with RE20's. And the RE20 has often been used where previously an expensive condenser was the automatic choice. Why? Because the RE20 has proved itself a significant advance in microphone design. With wide-range, peak-free response on axis (even the off-axis response is better than many other studio microphones on axis). Transient response rivals any other studio microphone, regardless of design. Directional control is uniform and predictable from every angle. Yet proximity effect is virtually eliminated (a problem that plagues almost every cardioid — except E-V Continuously Variable-D® microphones).

In short, the RE20 does everything a good condenser does, and some things better. Without the complication of power supplies. Or special cables. Or shock mounts or windscreens (they're both built in). Or the need for equalization just to overcome design faults.



It's simple. It's flat. It's rugged. It's clean. With a 2-year performance warranty unmatched in the industry (it's spelled out completely on the spec sheet). The RE20. For the studio looking for better sound. Your E-V microphone specialist will gladly loan your studio an RE20 to make any tests you like. Call him today.

P. S. For full technical data on the RE20, write us today. To find out more about Studio M, write Joe Kelly, VP, Engineering, Glen Glenn Sound Company, 6624 Romaine St., Hollywood, Calif. 90038

ELECTRO-VOICE, INC., Dept. 701A  
602 Cecil Street, Buchanan, Michigan 49107



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dynamic cardioid studio  
microphone \$425.00 list,  
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**Electro-Voice®**

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depend on  
**SHARPE**  
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for the  
**complete**  
sound —



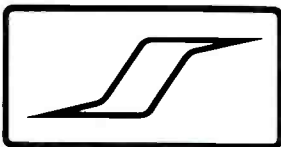
why  
don't you?

**SHARPE** Stereophones MKII with the smoothest frequency response from 15-30,000 hz (30-15,000 ± 3.5 db) are the choice of the professionals. After all, the pros know. That's why they're top rated.

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# AUDIO

Successor to **RADIO**, Est. 1917

JULY 1970

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AUDIO • JULY 1970



# There are 202 parts in a Garrard automatic turntable.

## We make all but a piddling few.

Today's automatic turntable is a beastly sophisticated device.

The Garrard SL95B, below, has 202 different parts.

That is, unless we tally the "parts" that go into such final assembly parts as the motor and pickup arm. In which case the total is more like 700.

A few of these parts we buy. Mostly springs, clips and bits of trim.

But the parts that make a Garrard perform, or not perform, we make ourselves.

### To buy or not to buy

At our Swindon works, in England, a sign reads "If we can't buy surpassing quality and absolute accuracy, we make it ourselves."

E. W. Mortimer, Director of Engineering Staff and a Garrard employee since 1919, says "That sign has been there as long as I can remember.

"But considering the precision of today's component turntables, and the tolerances we must work to, the attitude it represents is more critical now than it was even ten years ago."

Our Synchro-Lab motor is a perfect example.

To limit friction (and rumble) to the irreducible minimum, we super-finish each rotor shaft to *one micron*.

The bearings are machined to a

tolerance of plus or minus one ten-thousandth of an inch. Motor pulleys must meet the same standard.

"When you make them yourself," observes Mr. Mortimer "you can be that finicky. That, actually, is what sets us apart."

### Mass produced, by hand

Despite its place as the world's largest producer of component automatic turntables, Garrard stubbornly eschews mass production techniques.

Every Garrard is still made by hand.

Each person who assembles a part tests that finished assembly.

And before each turntable is packed in its carton, 26 final tests are performed.

Thus, we're assured that the precision achieved in its parts is not lost in its whole.

### Swindon, sweet Swindon

In fairness to other makers, we confess to a special advantage. Our home.

At last census the total population of Swindon, England was 97,234. Garrard employs a rather large share of them, and has for fifty years.

"Not everyone has been here from the year one as I have," smiles Mortimer "but we have 256 employees with us over 25 years. Many are second and third generation.

"It's hardly your average labor force. Everyone feels a part of it."

### The sum of our parts

Today's SL95B is the most highly perfected automatic turntable you can buy, regardless of price.

Its revolutionary two-stage synchronous motor produces unvarying speed despite extreme variations in line voltage.

Its new counterweight adjustment screw lets you balance the tone arm mass to within a hundredth of a gram.

Its patented sliding weight anti-skating control is permanently accurate.

And its exclusive two-point record support provides unerringly gentle record handling.

You can enjoy the SL95B, the sum of all our parts, for \$129.50.

Or other Garrard component models, the sum of fewer parts, for as little as \$44.50.

Your dealer can help you decide.



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**Garrard**<sup>®</sup>  
British Industries Co.

# COMING IN AUGUST

## COMMERCIAL SOUND ISSUE

**SOUND REINFORCEMENT:**  
Don Davis describes a method of using a computer to design sound installations.

**ELECTRONICS FOR PUBLIC ADDRESS:** Norman Crowhurst deals with some electronic and acoustic problems.

### EQUIPMENT PROFILES

include:

Heathkit AR29 Receiver  
Sony Model 366 Tape Deck

### PLUS

Record and Tape Reviews and all the regular features.



**About the cover:** Main theme is the Consumer Electronic Show held at New York's Americana and Hilton hotels. These buildings do not really face each other but are actually several hundred yards apart . . . Just artistic license. This year there are over 200 exhibitors and it is expected that some 30,000 dealers will trudge over the deep pile carpets to hear the demonstrations and see the new models. And if they develop a thirst in the process—who can blame them?



# Audioclinic

JOSEPH GIOVANELLI

## Rise Time

*Q. Would you please explain what rise time is?* Michael Speyer, Seattle, Washington

A. You have heard the term "transient response" used in discussions of high fidelity equipment.

This term is very closely interrelated with the term "rise time."

If a sudden impulse is fed into the input of a piece of equipment, that same impulse should be delivered to the output of this equipment without waveform distortion. In other words, if the input waveform has a square waveform, the output waveform should also be a square wave. If the output signal is not a square wave, this is an indication that the piece of equipment under discussion does not have good transient response, at least above a certain frequency. Because of a deficiency in the equipment, the waveform does not build up as quickly as is demanded by the input signal. To put this in another way, the waveform *rise time* at the output of the equipment is slower than the waveform *rise time* at its input.

## Resetting Turntable Speed

*Q. I just checked the speed of my turntable and found that it was running at 35 rpm rather than 33 $\frac{1}{3}$  rpm. Is there any way to adjust the speed?* G. V. V., Omaha, Nebraska

A. About all you can do to decrease the speed of most turntables is to grind down the motor shaft slightly. Of course, there are tables which are driven from built-in oscillators. If your table is one of these, you should determine whether it is oscillating at the correct frequency. It will be impossible for you to make such a frequency check without the aid of a frequency counter. If none is available, I suggest that the table be returned to the factory for adjustment.

Before doing anything to your table, check it with a strobe disc. This disc will immediately indicate the correctness of its rotational speed. If you timed the speed of the turntable with a stopwatch, it just might be that the stopwatch was running slowly.

Once you *know* that your table is running fast, you can then think about grinding down the motor shaft in order to bring its speed to its proper value.

Remove the turntable. Hold the drive puck away from the motor shaft. A rubber band slipped over the drive puck assembly and anchored to some part of the turntable assembly will serve nicely. Where the turntable was designed to operate at more than one speed, the motor shaft is arranged in a series of steps. The larger the diameter of the step, the higher the speed of turntable rotation.

Before attempting to make speed adjustments, be sure you know which step corresponds to the speed on which you are working.

You are now ready to begin grinding the step. Use a piece of emery cloth for this purpose. Turn on the motor and, while it is rotating, apply light pressure against the step to be ground down. Don't try to rush; it is much better to take a little longer and do a good job than it is to rush the work. You could grind off too much of the shaft, and the turntable would then rotate too slowly. In that event you would have to machine a bushing to fit over the step. Even at that, the bushing might be eccentric or it might not even be possible to attach it. In that case, you would have to get a new motor.

From time to time you must check the turntable speed when the table is running ever so slightly fast, you should use crocus cloth as the final grinding agent. This will polish the shaft.

The grinding action produces particles which can easily find their way into the motor bearings. Therefore, take the motor apart and clean the bearings very thoroughly and then relubricate. Some motors do not normally require lubrication. However, the lubrication in such motors can dry out, especially if you use a solvent to flush out dust particles. It is best to soak the bearings of such motors over night in oil. These bearings are designed to take up oil and retain it.

Remove excess oil and reassemble the motor. Your turntable should now be capable of delivering many hours of reliable service. Æ

If you have a problem or question on audio, write to Mr. Joseph Giovanelli at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.

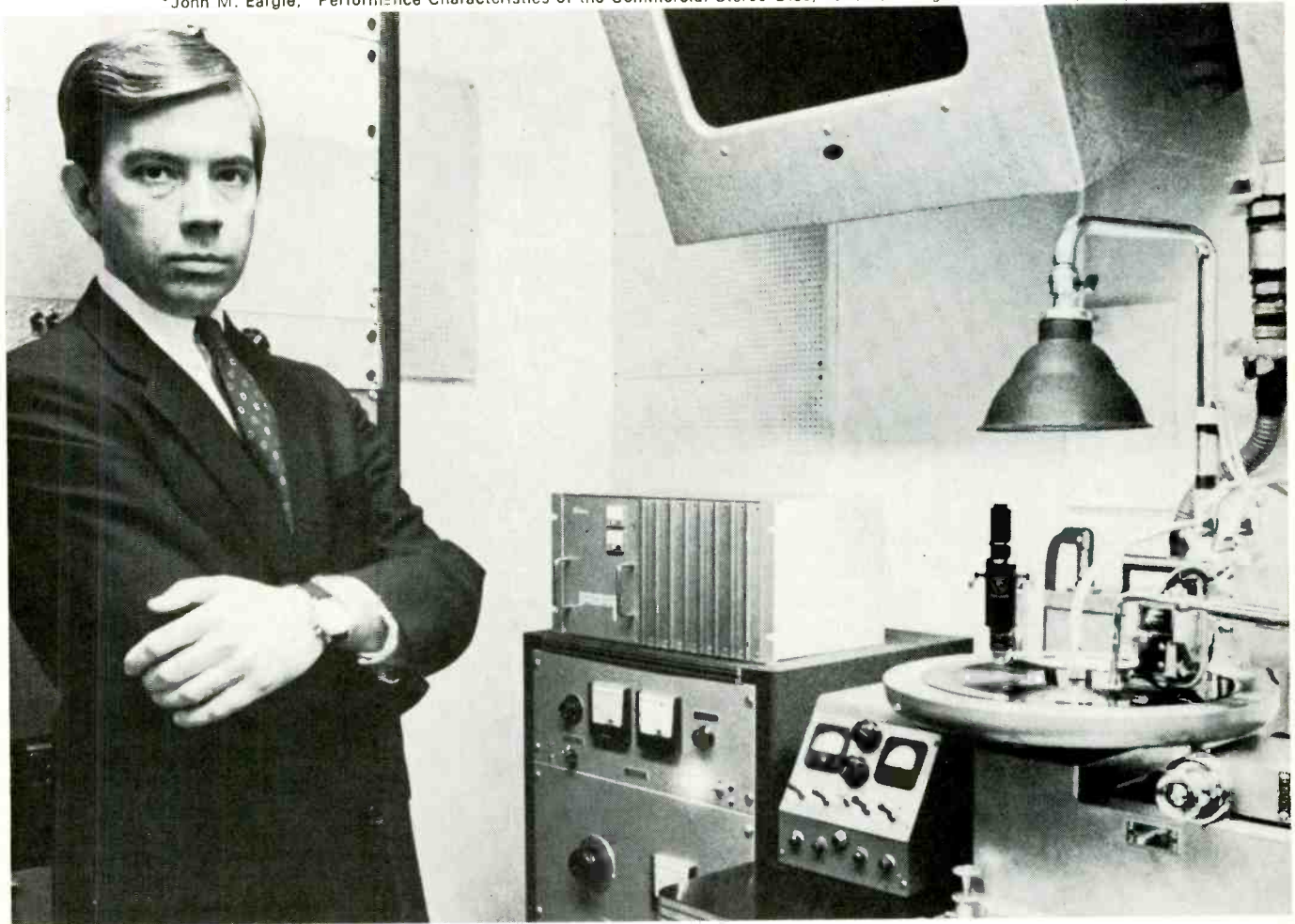


***"High quality pressings  
begin with quiet lacquer masters"—***

*John Eargle, Chief Engineer of Mercury Records.*

"We should never forget the impact that a low-distortion, low-noise master tape can have on the sound of a well made pressing. Recent studies\* have shown that pressings benefit from the use of the Dolby System even under the ideal conditions of cutting master lacquers from original low-noise tapes. Under more usual conditions the cutting is done from tapes once and even twice removed from the original, and in these cases the benefits of noise reduction are all the more apparent."

\*John M. Eargle, "Performance Characteristics of the Commercial Stereo Disc," *J. Audio Eng. Soc.* 17, 416 (1969).



Write for full technical details and advice on how the Dolby System can be of value in your own professional audio recording or transmission application.



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# 1970

# CONSUMER



Roberts 120



Bogen BR-60



Sherwood S-7100



Grundig RTV 650



Concord Mk 20



Nikko 1101

## new receivers ...

The **Roberts 120** is an AM/FM receiver with a rated output of 100 watts (IHF) and among the features are two tuning meters, built-in ferrite antenna for AM, external speaker switch and both DIN and standard phono sockets.

A FM sensitivity of  $1.5 \mu\text{V}$  is quoted for the **Bogen BR360** receiver which has a 'crescendo' control, a form of dynamic expansion/compression. This device is particularly useful for tape recording as it can help to improve the signal-to-noise ratio. Recordings are made with some compression and the necessary expansion is used for playback. Not as effective as a Dolby system but worthwhile for all that. The i.f. stages of the BR360 use ceramic filters and a mechanical filter is employed for AM. Power output is 100 watts (IHF)

The **Concord Mk 20** has a rated output of 240 watts (IHF) at 4 ohms with a FM sensitivity of  $1.7 \mu\text{V}$  and 20 microvolts for AM. Among the features of the Mk 20 are ceramic i.f. filters, patented fast-acting protection circuits, extension-speaker switching and special slide controls for tone, balance, and volume.

**Grundig's** model RTV 650 is a five-band (AM, FM, LW, and two SW ranges) receiver which should appeal to those interested in DX as well as Hi-Fi. There is a choice of five pre-selected stations on FM, a presence-lift control and a SW fine-tuning control. There are no less than 26 knobs (count 'em) on the front panel! FM sensitivity is given as  $1.5 \mu\text{V}$  and AM  $6.5 \mu\text{V}$ . Power output is stated to be 30 watts per channel rms which is probably equal to a total IHF figure of 100 watts. Incidentally, the LW band covers the range 145 to 350 kHz which is used by several broadcast stations in Europe.

**Model 1101** is a **Nikko** AM/FM receiver with some unusual features apart from the rather unconventional styling. It has two VU meters, an optional low-frequency boost to compensate for speaker deficiencies (10 db at 30 Hz) and ceramic filters are used in both AM and FM i.f. stages. A FET is employed as the AM detector. FM sensitivity is claimed to be  $1.5 \mu\text{V}$  and power output is 160 watts (IHF) at 4 ohms.

**Sherwoods** first low-price receiver is the **S-7100** rated at 100 watts (IHF) a FM sensitivity of  $1.9 \mu\text{V}$ . Price is \$199.95 and this model completes the Sherwood range of six models costing up to \$599.00.

**Fisher** will be introducing a very sophisticated receiver—the most ambitious yet produced by that company. This is **Model 701**, a 4-channel model featuring 40 watts per channel (RMS) 12 IC's, ladder filter, improved Autoscan, and provision for plug-in multiplex boards for use when standardization eventually takes place. A special 'wide-surround' control enables the user to change the characteristics of the rear speakers to suit room conditions or program acoustics. Price is expected to be around \$700.

**Pioneer's** new TX-700 AM/FM Stereo Tuner is part of the chain which includes the SC-300 Stereo Preamplifier, the SF-700 Electronic Crossover, and the SM-700 Stereo Power Amplifier—all combining to provide the functions of a multichannel receiver. The tuner alone has pre-set tuning for five FM stations and includes noise filter and muting ability. It is priced at \$199.95.

CES 70 CES 70 CES 70 CES 70 CES 70





3M/Wollensak 6154 Quad



Quatron 48-H 8-track



Roberts 333X



Concord Mk 8

## & tape recorders & ...

The **Wollensak 6154 Quad/Stereo** deck is a Quadraphonic 3-speed machine featuring sound-on-sound, electro-dynamic braking, separate bass and treble controls and bias selector. Available as a deck or with amplifiers and a set of four speakers.

The **Quatron 8-track** cartridge changer plays up to twelve cartridges with a choice of modes, e.g. all tapes in sequence, first-channel repeats of a single tape, or the automatic selection of any tape or channel. Two 15-watt amplifiers are built-in and matching speakers are available.

**Model 333X** is **Roberts** new three-in-one recorder with provision for reels, cartridges and cassettes. It features cross-field heads, dual VU meters and separate digital counters which facilitate tape transfers and comes complete with integral 12-watt amplifiers.

Another combined machine is the **Concord Mk 8** which has provision for 8-track cartridges as well as reel-to-reel. Total power output is quoted as 20 watts and features of the Mk 8 include two VU meters, sound-with-sound recording, separate tone and volume controls for each channel and simple press-button reel-(3-speed)-to-8-track transfer.

**Sansui** will be introducing its first tape recorder at the Show. This is a semi-professional 3-motor, 4-track machine with a price tag of around \$470. Features include a back tension switch to reduce strain on the tape during rewind and an automatic speed controller to protect tape from rough handling.

**Fisher** will be showing a new cassette recorder, Model RC-80 which uses the Dolby system and features dual-slide level controls, special ferrite heads, and complete with two dynamic microphones at \$199.

ces 70 ces 70 ces 70 ces 70 ces 70



H.K. Citation 11 Preamp



Hitachi TRQ-730



Altec 'Santana'



Kenwood KW-8077



Toshiba KT-401

At the top of the page is the new **Harmon-Kardon** Citation 11 pre-amplifier which has five sliding tone controls and many other refinements. **H-K** will also be demonstrating their new CAD5 cassette recorder which uses a Dolby system. Quadraphonic sound will be demonstrated using a processed system (Orban). This device can generate 4-channel sound from almost any type of program source—mono or two-channel stereo. **Kenwood** will be introducing a new range of tape recorders which include a 6-head machine (Model KW-8077, featuring solenoid controls and three motors with automatic reverse record/playback. Another newcomer is the **Hitachi** TRW-730-a 4-track machine with separate VU meters, slide pots, and separate record-replay heads. **Teac** will introduce a new high-performance cassette deck with a frequency response up to 12 kHz (-3dB). This is Model 824 and it incorporates a unique automatic shut-off device. **Altec** have a number of new products 'under wraps' but at least two speaker systems will be shown. One of these, model 879, or the Santana, is a floor-standing system using a 15-inch bass unit with a 3-inch voice coil, plus a high-frequency unit. It stands 24" high, 20" wide by 17" deep. **Toshiba** will be showing a large range of products including the KT-401 cassette recorder which has two level meters and a hysteresis-synchronous motor. **Dynaco** will be demonstrating their quadraphonic system (see page 24) using a Dynaco SCA 80 or a Stereo 200. **Mikado Electronics** will also have a quadraphonic setup: this one is called the Dorren system and a special 4-channel FM transmitter will be used with a standard Mikado receiver fitted with a decoder. The inventor, Lewis Dorren will be at booth A-235 to answer any questions. All we can say is that (a) the system is compatible, (b) it uses a form of multiplexing and (c) it is unsuitable for disks. **Koss** have a new improved dynamic headset, Model PRO4-AA which is said to give sound reproduction close to electrostatic headphones. 'Geometrically correct' stereo is claimed and harmonic distortion is less than 0.5% at 110 dB SPL. Price is \$60 and they will be available in September. **Bogen** will also be introducing new headphones: Model EP-10, which has an extended high-frequency response and is priced at \$29.95. Also on show will be a new speaker system—model LS-X which measures 12" by 5" by 9" and uses a 4" full-range speaker. Price? \$24.95. **BASF** is introducing a specially developed low-noise recording tape which is stated to have a dynamic range at 3¼ ips superior to many standard tapes played at 7½ ips. It is called LH (Low-noise, High-output) and is available in lengths from 990 to 3,600 feet.

Continued on page 49



# JVC introduces the New Super Naturals

Fabulous new features plus Advanced SEA\*  
add up to the ultimate listening experience — Super  
Natural Sound! Yours to enjoy in four exciting new models from  
JVC. Check them out at your dealer today. Or write us direct  
for color brochures and the name of your nearest dealer.



**JVC Model 5010.** Moderately priced AM/FM multiplex stereo. Has Advanced SEA with knobs that click up or down in 2db steps within a range of  $\pm 12$ db, just like the more expensive models. 40 watts total dynamic power. Five IF stages. New FET reaches out for distant FM stations. 1% IM distortion. Accommodates 2 speaker systems simultaneously. Wood cabinet.

**JVC Model 5020.** Superb AM/FM stereo with Advanced SEA. Automatic FM. 75 watts dynamic power. FM linear scale dial. FET ultra-reliable circuitry. Separate pre-and main amplifier sections. 1% IM distortion at rated power. 30-30,000 Hz bandwidth for crisp, clean sound. Wooden cabinet at no extra cost.



**JVC Model 5030.** Sophisticated beauty. AM/FM multiplex stereo with automatic FM and Advanced SEA. Brilliant 140 watts output. FM linear scale dial pinpoints stations on crowded FM band. IC modules plus new ultra-sensitive FET frontend. 15 to 30,000 Hz bandwidth. Infinitesimal 0.8% distortion. Built in pre-and main amplifiers. Wood cabinet.

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# BEHIND THE SCENES

BERT WHYTE

I had hoped to give you a report on live recording of four-channel stereo, but have had to shelve the project temporarily. Not from lack of equipment or anything like that, but for the more basic reason of lack of co-operation among the parties involved. Not to worry . . . I've gone through this sort of thing before in the early days of stereo, and these problems will soon be resolved.

There has been considerable activity on the four-channel front, some of which is quite significant. I think that even the most enthusiastic advocate of four-channel sound would have to admit that in the general hi-fi scheme of things, this "new sound" has had relatively little impact on the status quo. There are those who say that four-channel sound is largely a promotional gimmick, something that given time might catch on with the affluent audiophile. There is certainly an element of truth in this, but a recent development is about to change the entire four-channel picture.

As noted elsewhere in this issue, RCA has decided to exploit four-channel sound in a big way. What was an esoteric development and the plaything of the audio avant garde, has suddenly become a *product*, which will be promoted with all the power of mass merchandising. It is interesting that RCA is the company involved, sort of like history repeating itself, since they were the first major company to issue two-channel stereo tapes in 1954 and that really started the stereo boom. I do not mean in any way to denigrate the pioneering efforts of Vanguard. They were first in the field and deserve much credit for the courage of their convictions. And I am sure we will see more forward-looking developments from this enterprising company. However, it is obvious that a company like RCA has the money and the means necessary to make four-channel sound a viable entity in the field of consumer stereo. Let us take a brief look at what RCA has developed.

We can guess that some smart lad took a good look at an RCA Stereo 8 cartridge and the light suddenly dawned that here was a quick and easy way to provide four-channel sound . . . to wit: instead of four two-track stereo programs, the same eight tracks could accommodate two four-channel stereo programs. This is just exactly what RCA has designed. Thus they have ready for marketing this fall what they call the YZD-400 four-channel sound system. This consists of what ap-

pears to be a conventional 8-track cartridge player, mounted in a cabinet with self-contained speakers to the left and right of the player unit. However, the player has a four-channel head and four amplifiers and two external speakers are provided which plug into the player unit to furnish the rear audio channels. Left/right balance controls are provided for front and rear speakers and there is a ganged volume control to raise or lower the level of all four channels. The four-channel cartridges which RCA has dubbed "Quad 8" look like the conventional 8-track variety, but use slightly thinner tape. These Quad 8 cartridges will provide up to 25 minutes of music on each of the four-channel programs, thus making them roughly equivalent to the playing time of the average LP record. This matter of playing time puzzles me somewhat. In standard 8-track cartridges you can get up to 80 minutes of playing time. One would assume that with the use of a thinner tape, even more playing time would be provided. Since the four-channel head will shift from one four-channel stereo program upon its conclusion, to the second four-channel program (on the endless tape loop basis) there would not seem to be any technical reason for the overall playing time to be less than that of the standard 8-track cartridge. I suppose we will know the reason for this before long. In any case, if a total of 50 minutes is the limit, certain music like some of the Mahler symphonies and most operas would require more than one Quad 8 cartridge. The new Quad 8 player is completely compatible with present 8-track cartridges. Initially, the player unit will have a "mode adjust" button, which selects either four-channel or conventional two-channel stereo. It is hoped that eventually a "sensing slot" can be molded into the cartridges which would allow the player to select automatically either two-channel or four-channel stereo modes of operation.

Now here is a quote from RCA which has hidden significance: "Players will have left front and rear, and right front and rear speakers with *completely discrete channels for each*. The new dimension of realism is thus achieved *without sacrifice of conventional stereo separation*." At this time there are a number of quadraphonic systems in being which employ various methods to produce four channels of sound which differ from the original four-channels-in-line on tape as used by Vanguard, for example. At this stage of

development, it would not be fair to reveal which process was involved, but this particular one was demonstrated to RCA and obviously on the evidence of the Quad 8 development, was rejected. One of the criticisms most often leveled at these systems, is reduced stereo separation, which apparently is why RCA makes a particular point about their "conventional stereo separation."

The four-channel stereo systems I have been using in my home costs thousands of dollars. Thus it is slightly shocking to find out that the cost of this RCA YZD-400 Quad 8 is \$199.95. Obviously with small speakers front and rear and low-powered amplifiers, one doesn't expect a very opulent sound. Nevertheless, it will be interesting to hear to what extent the four-channel stereo aids the sound we normally expect from such inexpensive equipment. More to the point is the fact that four-channel stereo is being offered at a low price to the mass market. The ramifications of this are enormous, and unquestionably this development is reshaping the thinking of many in the industry. One thing seems reasonably certain . . . in one format or another, four-channel stereo is no longer the exclusive province of the audiophile and it looks as though it is here to stay.

Presumably RCA will eventually offer their four-channel player in deck form, and this, combined with amplifiers and speakers of good quality, will receive the attention of many audiophiles. As to RCA four-channel repertoire, they have been recording in this mode for many months now and have built up a catalog of some 25 titles ranging from "Hair!" to the Mahler 2nd Symphony with Ormandy and the Philadelphians. All of their recording is now done in four-channel stereo, so the catalog should build up quite rapidly. This being so, one can surmise that when circumstances dictate, RCA could move quickly into four-channel cassettes and in whatever form the four-channel disk finally appears. May I respectfully suggest to RCA that the oft-maligned but quality-conscious audiophile is still the man responsible for this entire hi-fi industry. Give him a break. Do as you did in 1954 . . . issue your four-channel stereo on open-reel tape. It is just as easy, in fact more so, than your new Quad 8 cartridges. Why not go whole hog and issue them in "Dolbyized" form as well? You'll get a very grateful group, who will broadcast your message everywhere with typical audiophile fervor.





## Bones Howe and Friend(s)

It's always nice to get fan mail — especially when it's from a living legend in the recording industry. Bones Howe (producer of the magnificent recordings featuring The 5th Dimension) told us the Shure SM53 was his "friend"—in his own words:

"I used the Shure SM53 microphone virtually without equalization on the Jeff Comanor recording sessions (see photo at bottom left), and The Carnival sessions (see middle photo). I added only +2db at 3000 Hz equalization to provide a little 'edge' in the Ronnie Darling

and Smokestack Lightnin' session (see photo at bottom right).

"It has a much warmer quality on guitars and other stringed instruments.

"I noticed NO handling noise from the SM53 when it was hand held.

"I recommend it for better sound quality in studio use, and as a great high-quality general purpose microphone for remote recordings."

We can tell you about *eight* provable advantages that can make the SM53 your most effective and reliable recording microphone.



## SM53 Unidirectional Dynamic Microphone

Shure Brothers Inc., 222 Hartrey Avenue, Evanston, Illinois 60204



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In a parallel development, Motorola announced it was building automobile players for the RCA four-channel stereo cartridges, that they had already demonstrated the system to major car manufacturers, and that it was expected to appear in some 1971 and 1972 models. Gadzooks! To use a well-worn cliché, the mind boggles. One must assume that virtually all four-channel car tapes will be of the pop variety, because the high noise levels of the mobile environment would swamp the rear reverb of classical productions. In any case, this is but one

more indication that things are moving very rapidly in the four-channel field and it can no longer be dismissed out of hand as a mere gimmick.

You know, in this audio business you can never take anything for granted. Or assume that if a problem is solved, it stays solved. A good case in point is this business of spherical versus elliptical styli. Over the past few years it has been generally assumed that the elliptical styli tracked better and produced less distortion, especially at the inner grooves, than it's spherical counterpart. This was held

to be true even with records cut with a stylus correlator, which meant RCA records since the correlator was used only by them as part of the original "Dyna-groove" process. Incidentally, for many years now, the only part of the "Dyna-groove" still used is the stylus correlator. While the name still appears on RCA records, it is no longer meaningful. Now it appears that some of our diligent researchers and theorists have come up with new information which seems to reverse the present ideas about elliptical styli. Although all the research is not yet conclusive, it would seem that better tracking and less distortion are obtained with spherical styli of 0.7 and 0.5 mil radius. They are even experimenting with 0.35 mil styli! If mention of the "half mil" stylus seems to ring a bell, you may remember that spherical styli of that radius were considered the last word in the later days of the monophonic cartridge. At any rate, I am being sent some 0.7- and 0.5-mil styli and we will have a listen. These same researchers are upsetting other apple carts too . . . For example, in the matter of skating-force adjustment, which is a feature of most modern arms, you are told via a chart that at X stylus force, you should dial in X skating compensation. All well and good . . . except that our friends have determined that the various record companies use varying types of vinyl compound to press their records. These differing types of vinyl have different co-efficients of friction, thereby invalidating any so-called standard setting. But take heart, there are still those engineers who pooh-pooh the whole idea of skating compensation. In fact, as one engineer friend of mine who is quite prominent in phono cartridge research said recently . . . "you can prove that cartridges and records have all kinds of distortion, but most of it is in fairly exotic areas and if you take care to eliminate or reduce the most basic distortions, the ear can happily ignore all the rest." My friend went on to say that the "basic distortions" in many cases can be traced directly to poor installation of arms, especially as regards correct positioning between the turntable spindle and the arm pivot, and the correct turntable/arm height adjustment. He also pointed out that when cartridges are installed in arms, the slightest deviation from true perpendicularity to the record surface can aggravate several forms of distortion. Finally, the thing he deploras most is the fetish of super-light stylus forces. In a certain few arms, he said, they can operate successfully at one gram or less. For the rest, he says that more distortion is produced by the stylus rattling in the record groove at excessively light forces than all the rest of the arm/cartridge distortions put together. **AE**

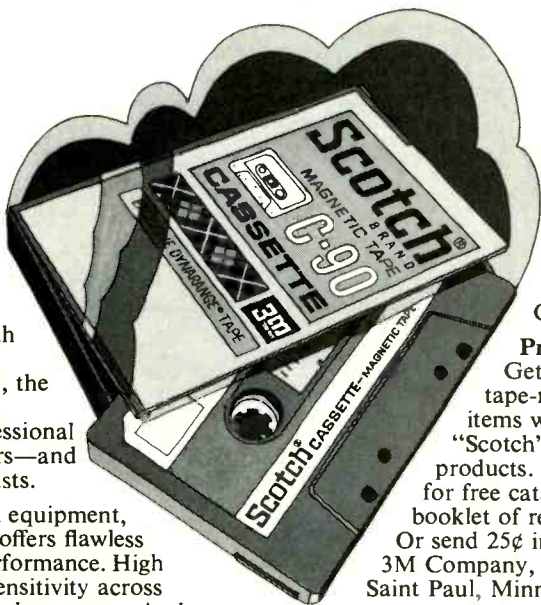
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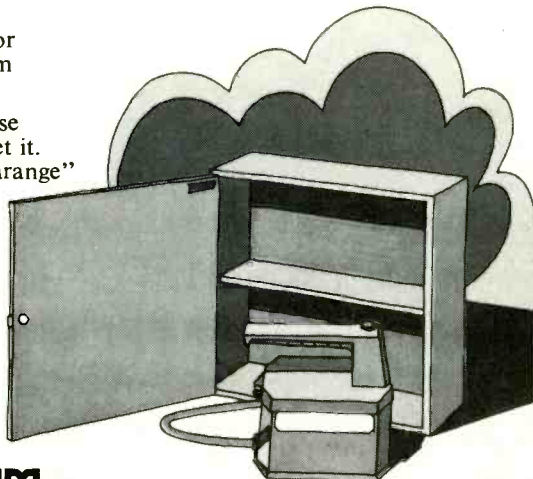
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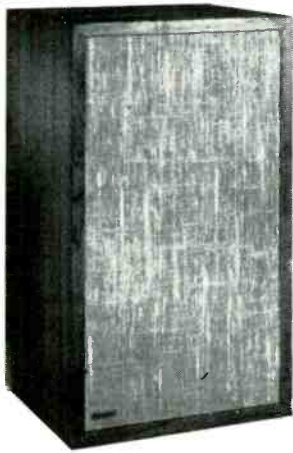


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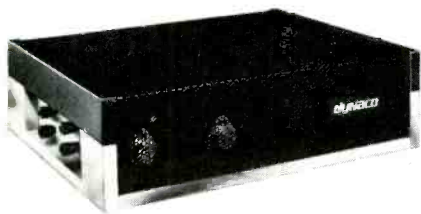
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# Tape Guide

HERMAN BURSTEIN

## Sound On Sound

*Q. Is it possible to install sound on sound in a tape recorder that doesn't have this feature, either by an internal connection or an external device?*  
—Jeffrey Cripps, Webster, N.Y.

A. The requirement for sound on sound is that you be able to record on one track (say Track 3) while playing back another track (say Track 1); also that you be able to mix two signals to be recorded on Track 3—the signal being played back on Track 1 and a new signal; and that you be able to monitor the Track 1 playback in order to synchronize the new signal you are adding to it. All this is not very simple, and if your machine doesn't already provide for sound on sound, it would take a fair amount of work to convert your machine.

## Tape Head Input

*Q I have been interested in purchasing a tape transport to feed into the tape-head input of my audio system preamp. This purchase poses several problems. (1) There are almost no manufacturers of tape transports (sans electronics); then why do nearly all amplifiers and preamps have a tape-head input? (2) I understand there are problems associated with equalization of playback-head output, especially in the bass. Is there any way to remove the peaked response in the bass without recourse to the playback electronics, or without having to have a playback amplifier? (3) I assume that most of the differences between 7.5-ips and 3.75-ips playback equalization can be compensated by the tone controls of my audio system amplifier. Is this true?*—John R. Bates, Philadelphia, Pa.

A. (1) The tape-head input seems to be something of a relic, like the human appendix.

2. As the horizontal dimension of the playback head approaches the size of a recorded wavelength (which happens in the bass region), the entire head and not merely the gap tends to react to the magnetic flux on the tape, thereby augmenting bass

response. I do not know of a way of eliminating this except to make an extremely large head.

3. If by "most" you mean most and not all, then it is fairly true that "most of the differences between 7.5- and 3.75-ips playback equalization can be compensated by the tone controls." If you are using 7.5-ips equalization to play a 3.75-ips tape, you would supply some bass cut and some treble boost.

## Quarter- vs. Half-Track

*Q. Which is better—half-track or quarter-track for stereo operation?* (Lee C. Stauffer, Los Angeles, California)

A. In today's state of the art, nearly as good performance can be achieved with quarter-track as with half-track. However, signal-to-noise ratio is somewhat better with half-track. On the other hand, correct azimuth alignment is more critical for half-track. With half-track, there is greater freedom from "left-channel dropout" (lower signal level on the left channel). If you plan to edit your tapes, you cannot do so if tracks have been recorded in two directions; hence for stereo you would want half-track operation (recording in one direction only).

## Tape Storage

*Q. Can tapes be stored in steel cans to shield them from the earth's and other magnetic fields, or would the can become magnetized and thus subject the tapes to a field which would adversely affect them? Is there any way to protect tapes from stray fields during storage?* (R. Hawkins, New York, N.Y.)

A. I doubt that recorded tape is apt to suffer from the earth's magnetic field. However, it may suffer injury if brought close to powerful motors, transformers, and the like with a magnetic field extending an appreciable distance. Then it becomes meaningful to store the tape in a steel can. Better yet, cans made of a special shielding material are available.

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.



# Sony announces the final step in the evolution of the condenser microphone.

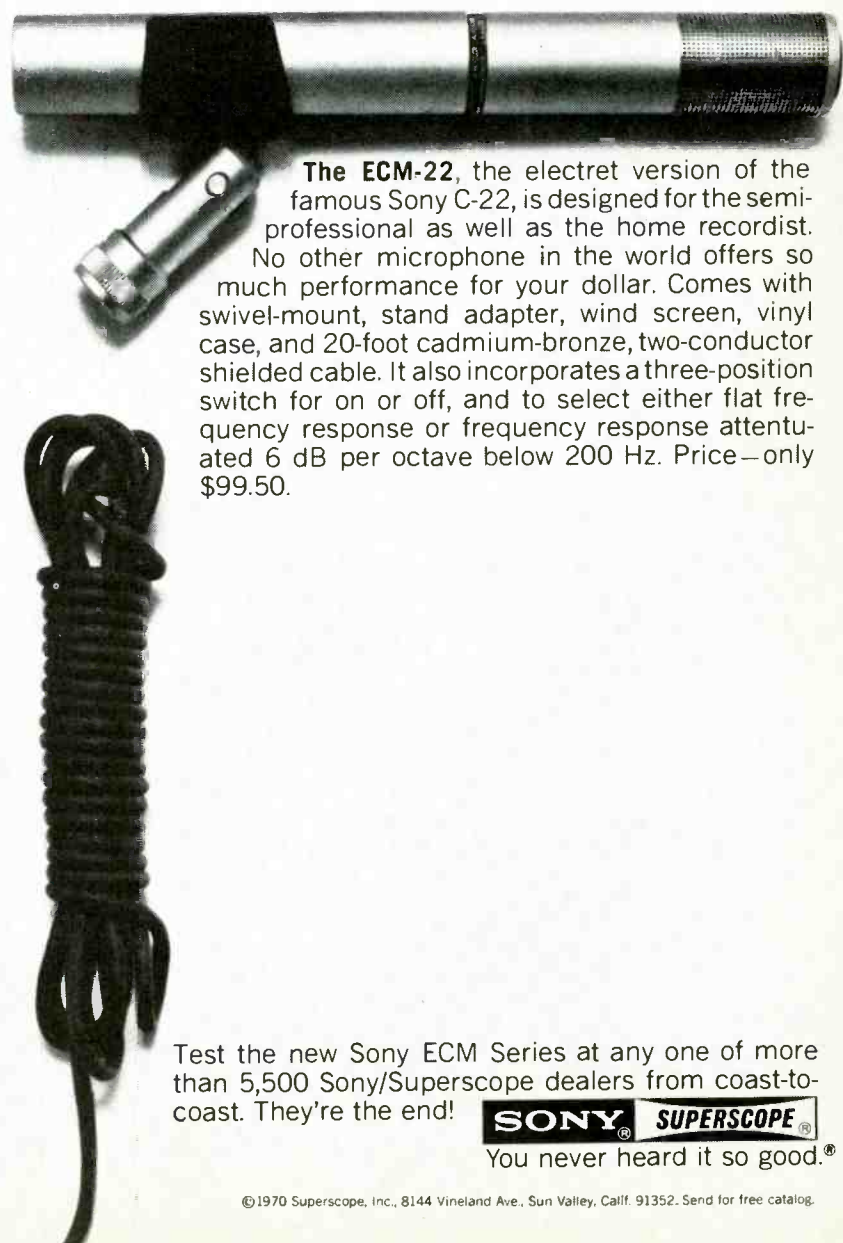
Here is the first professionally engineered microphone series designed for the audiophile and semi-professional: The Sony ECM.

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**The ECM-19B** enables the home recordist to bring out the full potential of his tape recorder with the kind of performance only a condenser microphone can provide. Comes with desk stand, swivel-mount for standard mike stand, 1.5-volt dry battery, and 10-foot cord with mini plug. Price—only \$29.50.



**The ECM-22**, the electret version of the famous Sony C-22, is designed for the semi-professional as well as the home recordist. No other microphone in the world offers so much performance for your dollar. Comes with swivel-mount, stand adapter, wind screen, vinyl case, and 20-foot cadmium-bronze, two-conductor shielded cable. It also incorporates a three-position switch for on or off, and to select either flat frequency response or frequency response attenuated 6 dB per octave below 200 Hz. Price—only \$99.50.



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# Editor's Review

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According to the EIA, 1970 marks the Golden Anniversary of the Consumer Electronic Industry. It is true that the loudspeaker and phonograph were invented long ago in the eighteen-seventies and radio not so many years after, but 1920 was the year in which broadcasting began and when radio receivers were on sale. This was three years after *Radio* magazine (later to become *AUDIO*) was founded. The change in name took place in 1947, the year that saw the invention of the transistor which has caused such a revolution in electronics. Stereo made its debut—at least commercially—in 1958, and now interest is centered on 4-channel sound. At the Consumer Electronic Show, the great majority of exhibitors in the audio field will be demonstrating some kind of quadraphonics using reel-to-reel and 8-track tape, disks, and FM with internal 'transmitters'. No doubt we will have a standard system before very long but this must be said: whatever system is adopted for FM and disk, matrix, multiplex, psycho-acoustic, synthetic, or what have you—the results must be comparable with that obtainable from the best quadraphonic tapes. I said *best* deliberately because some of the alleged 4-channel tapes were made by the simple expedient of 'mixing down' from the original 16-track recordings.

\* \* \*

If you could examine the groove(s) of a modern stereo record under a high-power microscope you would be astonished at the complexity of the waveforms cut—or rather pressed into the vinyl. Furthermore, if you could see the whole series of processes involved, from the studio to the finished product you would realize what a near-miracle of mass production the phono record really is. . . . That said, it must be conceded that we *do* get a fair number of complaints about disk quality—some justified, some not. Here are extracts from a recent letter written by David Grossman of New York ". . . I think it is time someone exposed the negligence of the record industry and began a campaign for an up-to-par product. . . . I have an Empire 999 cartridge and take meticulous care of my records in spite of the inferior quality of the disks on sale. Looking over my collection, I find less than a quarter of the disks are properly made. The remaining records feature a great number of defects including off-center holes, thin flimsy disks, inferior pressings, and surface scratches." Now

some of these troubles might originate with poor storage or careless handling at the dealer's but many are certainly due to poor quality control. Other letters complain about indifferent sound reproduction and here the record reviews can often save money being wasted. I discussed this problem with Douglas Sax of a Hollywood mastering studio on a recent visit there and Douglas, who is a perfectionist, had an interesting suggestion to make (That is—when I finally got him away from his Scully!) The proposal was to form a committee of those concerned—the makers of cartridges, turntables, and so on—to judge records and then give a Seal of Approval to those surviving the tests. Trouble is, even if the idea worked and we had a hard-working, altruistic committee happily engaged in awarding Gold Seals—it would still leave the problem of variations in pressings, off-center holes, and other faults to plague us.

The record companies may not get that many complaints because a high proportion of the records sold feature rock music of some kind or other and eccentricity and warps might even *improve* the sound. After all, rock 'musicians' often introduce electrical distortion when recording. One device for creating this distortion is advertised as giving 'that dirty sound reminiscent of overloading in early tube amplifiers'! So now you know . . .

\* \* \*

I hope most readers will have noticed the increased space given over to equipment profiles. Pictures and diagrams are larger and more technical information is given—although this may mean fewer products are reviewed. We get letters from time to time asking 'why do we not review *this* receiver or *that* speaker'. It is not always a question of space—some manufacturers, like McIntosh, just cannot make enough of their products and so they would rather not have a review now. Nothing we can do about it!

\* \* \*

The New York Audio Society is holding a meeting on July 29 and the main feature will be a demonstration of TDK cassettes by representatives of that company. A film will also be shown and it is said 'there might be some surprises' (surely not *those* films?). The venue is the Dragonseed restaurant on 37th Avenue at Jackson Heights, and the time: 8 p.m. G.W.T.



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All Stanton Calibration Standard cartridges are guaranteed to meet the specifications with exacting limits. Their warranty comes packed with each unit—the calibration test results for that individual cartridge.

For complete information and specifications write Stanton Magnetics, Inc., Terminal Drive, Plainview, L.I., New York.



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And because Marantz Imperial performance is so clean and crisp, you can enjoy music for hours on end

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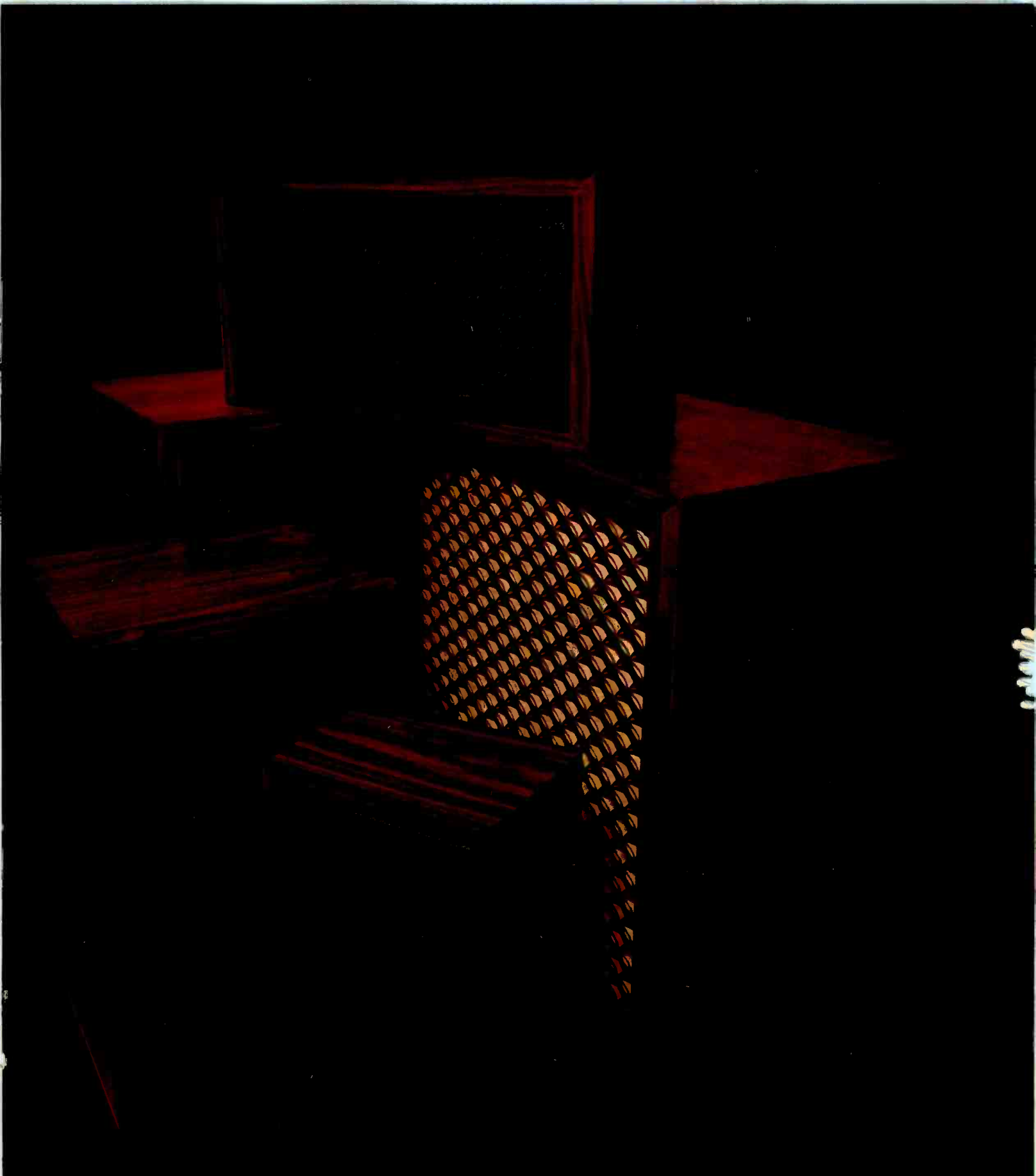
Marantz bookshelf-size speaker systems, the Imperial III, IV, and V are engineered for maximum power handling capabilities. For example, the Imperial III can handle over 100 watts of continuous RMS power, has a 12” acoustic-suspension woofer, separate midrange, and high frequency dome-type speakers.

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# A New Quadraphonic System



DAVID HAFLER\*

THERE HAS BEEN CONSIDERABLE experimental effort devoted to enhancing sound and music reproduction by using multiple channels. Stereophonic reproduction using two channels was a major step in the direction of using as much information as possible in recording and playback. Two channels give a better impression of the hall characteristics than one channel, and also give increased accuracy of localization of instruments. It is natural to try to extend this to more than two channels in order to obtain even further benefits in these directions.

The general goal in increasing the number of channels is two-fold: 1) to reproduce ambience of the original concert hall or space in which the recording was made; 2) to obtain specialized sound effects such as positioning the listener in the center of the sounds, or by having sound energy shift from front to back, as well as from left to right.

However, as soon as an attempt is made to utilize more than two channels, the economic problems are increased. More amplifiers and speakers are required, and we come up against certain limitations which are imposed by our recording and reproducing methods. For example, phonograph records can supply two channels with quite good fidelity. In order to obtain additional channels, it would seem necessary to use some multiplexing or switching system which requires far greater bandwidth. This greater bandwidth is difficult to reproduce with present recording and playback methods. If it is based on high-frequency multiplexing, there is great difficulty in getting undistorted high-frequency reproduction outside the normal audio spectrum.

In similar fashion, stereo radio transmissions utilize most of the bandwidth allocated by the FCC. Any attempt to impose additional information either requires revision of the FCC rulings, or limiting bandwidth of the extra channels of information.

Although recording and reproducing systems using four independent channels have been demonstrated to be both possible and effective, cost and incompatibility for all media operate against them.

\* Dynaco Inc.

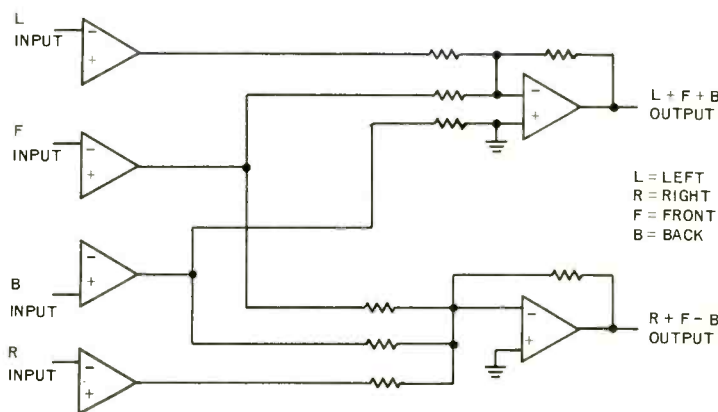


Fig. 1—Adding Front information In-Phase and Back information Out-of-Phase to left and right channels.

Fortunately, these systems are still in the embryonic stages, and the industry has made no major commitments to them, since there are other alternatives which can produce the benefits of four-channel sound without the limitations of existing methods and at far lower cost.

## A New Multichannel System

Obviously if a system can be derived which can utilize two conventional stereo channels but contain additional information, this system will have large commercial advantage and should make the multichannel system popular for mass markets. This paper describes a simple system for adding additional information into two stereo channels in such a way that multichannel reproduction can be approximated, and the system is compatible with present recording and playback techniques.

This technique is based on adding additional information into the two stereo channels. Straight addition does not require additional bandwidth, and can be done by the most simple summing or mixing networks. The difficulty with such an approach is that the information which has been added cannot be easily extracted and utilized later. Once the information is added, it becomes part of the normal two-channel information, not distinguishable from the other material in these two channels. Fortunately, however, there is a simple technique by which identical in-

formation in the two channels can be eliminated. This can be done by direct subtraction of the channels if the information is identical in both phase and amplitude in each channel; and it can be done by addition if the information is equal in amplitude and opposite in phase.

Figure 1 shows a simple block diagram on which this method is based. In the recording process, there are multiple channels of information. Here are shown four specific channels; the left channel, marked "L"; the right channel, marked "R"; the front information (from the rear of the hall) marked "B". These signals are combined in such a way that we have available  $L + F + B$  and  $R + F - B$ .

In order to introduce this information into two channels, we must recognize the fact that modern recording techniques use multiple mixing setups. Conventionally now, as many as sixteen channels, some with several microphones, are used. Some are positioned to pick up different segments of the source; and others are positioned pointing toward the rear of the hall to pick up reverberation in order to introduce some of the hall ambience. In our simple block diagram of Fig. 1, the left-side information is a composite from several microphones arranged so as to pick up sounds predominantly from the left side of the hall; similarly the right information discriminates in favor of the right side of the hall. Concurrently, there are microphones which favor sound from cen-



If spec sheets are among your favorite reading, we don't blame you for getting confused at times. Columns of figures aren't always too eloquent on their own, only in context or comparison with other specs. And statistics can be used to support anything — especially statisticians.

So it's nice to know how to read between the lines of a spec sheet. To know, for instance, that not all makers use the same measuring standards. Take overall frequency response: ours is measured at a  $-10\text{dB}$  level, the accepted broadcast standard. Yet certain other brands measure from as low as  $-24\text{ dB}$ .

Unfair to us? Yes. But more important, it's unfair to you.

Of course, there are other ways to play the numbers game. We say go ahead and compare specs till your head spins. But do it right: consider your own overall needs and objectives. Consider specs in relation to other specs on the same component. Compare that unit spec for spec, *standard for standard*, with competing models. Then go give a listen.

True, you can't be a computer.

But you shouldn't have to be a speculator, either.



# TEAC

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# NUMBERS GAME.



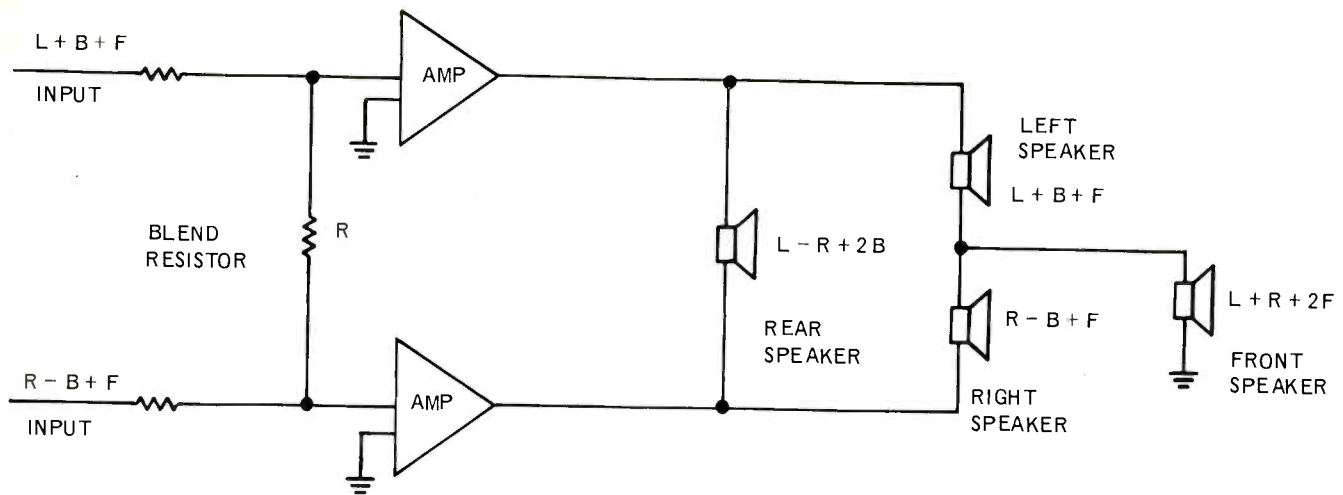


Fig. 3—Showing a method of using a derived center channel to produce four channels.

ter of the orchestra or front of the area. This sound is mixed equally in both left and right channels, and is the "F" information which becomes common to these channels.

Again, in Fig. 1, there is information labeled "B" which represents back information. This is information which is combined from microphones pointing toward the rear of the hall and/or possibly from microphones placed at the rear of the hall and pointing forward. What is picked up in these microphones has a lag time representing the time it takes for sound to travel from front to back of the hall. It is this time lag that gives the hall some of its distinctive audio characteristic. Part of this back information also contains reflected signals from the rear which are deficient in high frequencies due to absorption of highs; and although these are not normally audible to the listener in the hall, they do contribute to the overall characteristics of the sound as reproduced in that hall. Also, of course, some music utilizes instruments at the rear of the hall.

In Fig. 1 the two output channels, the augmented left and right, contain our

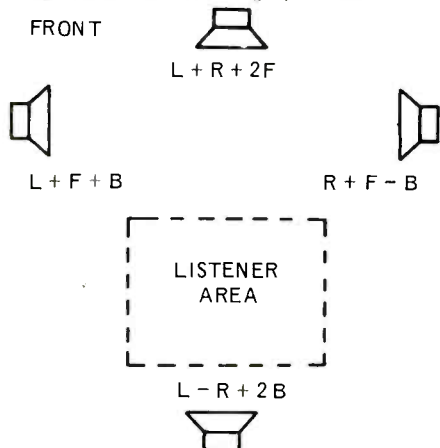


Fig. 2—Showing speaker arrangement.

left and right information, plus *front* information which is in phase in both channels, plus *back* information which is now *out of phase* in the two channels. A very simple loudspeaker arrangement can be set up to play this information back in a way which uses the additional dimensional information. Figure 2 shows a suggested arrangement. At the front of the listening area, a speaker is connected which is driven by the sum of the two channels. When these are added and played at the front, the "B" portion is cancelled leaving  $L + R + 2F$ . At the two sides the two individual channels are fed directly, one with  $L + F + B$  and the other with  $R + F - B$ . At the rear of the listening space, the difference between the two channels is reproduced giving  $L - R + 2B$  with the "F" signal cancelled.

Figure 3 shows an electrical connection which can give these two separate channels and the sum-and-difference signals in the most simple possible hookup. The  $L + R$  signal is obtained by using the Dynaco method of deriving a center channel.<sup>1</sup> That connection gives the sum in the center speaker, without crosstalk, utilizing only a single blending resistor shown as R in the diagram. The speaker in the rear which produces difference information uses a differential connection across the output of the amplifiers. Other systems, of course, can be used such as a phase-inverting transformer to produce the sum signal. However, the system of Fig. 3 is the most simple available means.

This multichannel system is a logical outgrowth of experimentation using a derived center channel in which the center loudspeaker produces the sum of the two channels. The information common to those channels—that which is of identical amplitude and phase in both chan-

nels—is the center sound either obtained by a separate directional microphone or from equal pickup in the two side microphones. By adding the two channels, such common sound is emphasized relative to the side signals since it doubles (by algebraic combination). In this expansion of the principle, the system is inverted so as also to produce additional back sound which is emphasized in the rear loudspeaker.

The inversion consists of carrying the extra back information in *opposite phase* in the two channels and reproducing it through *subtraction* of the two channels to produce the difference signal in the rear. It is evident that subtraction will eliminate in-phase signals (so no front signals appear in the rear) just as adding of the two channels for the front speaker will cancel the out-of-phase signals up front (so no rear signal appears there).

For a listener in the central area both front and rear are producing the same kind of effect each with a derived center channel, but these channels can carry different and non-interacting information simultaneously; thus adding front and rear information to conventional left and right stereo.

Referring to Figure 2, we see that there are differences in the sounds which come out of the four different speakers depending on the localization of the original sound source and the corresponding microphone position. At the front of the playback area is sound which normally was centered in the orchestra, plus some of the side information. At the rear the signal is predominantly what is obtained from the back microphones, plus some left and right information. At the sides of the hall is the information for left and right signals and some of the front and back information.

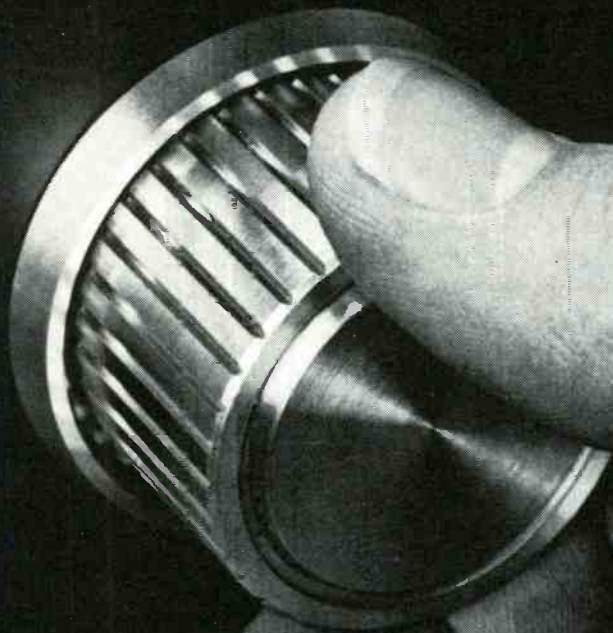
(Continued on page 56)

<sup>1</sup> Patent No. 3,417,203. Stereo System with Derived Center Channel.



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\*Suggested List



## Stereo Tuner

Continued from page 21

noise ratios are good, the residual readings will accurately reflect the separation.

However, you may find the residual signal easier to read if you bypass the pre-emphasis circuit in the generator. When going this way, don't let yourself be deluded by apparently excellent separation at high frequencies. The decoder's de-emphasis always reduces the high-frequency output, but the generator is not increasing it to yield a flat signal. The dB value of the de-emphasis curve must be subtracted from your readings to yield the true separation.

The output from the tuner should stay within the shaded portion of the curve shown in Fig. 7. The nominal values to subtract from your readings are listed in Table 1 as "dB down from ref." If you wish to measure separation more accurately, measure its response and use those values for the ones to be subtracted.

Connect the scope to one of the tuner audio outputs. Adjust the scope so that you can see the residual 19- and 38-kHz signals. Adjust the 19- and 38-kHz filters on the decoder for the channel you are watching to get the minimum output. Repeat for the other channel.

With the 19- and 38-kHz filters in the tuner properly adjusted, the increase in the residual distortion from a mono signal to a stereo signal will not be more than a doubling of the percentage of distortion. Example: 0.5 per cent mono will not be more than 1 per cent stereo. On high-quality stereo tuners, you can expect little or no change.

If the internal 38-kHz oscillator is clean, and the i.f.'s are properly aligned, there will be no change in the distortion for a composite signal between the PHASE TEST, LEFT, and RIGHT signals.

As a final test, the tuner should perform just as well with a weak r.f. signal from

the generator as with a strong one. Make the weak signal just strong enough to give a good signal-to-noise ratio. This is another area of difficulty, as an improperly aligned i.f. section will change its response with a change in the signal strength. When the change is symmetrical, it is acceptable. Any other change is unacceptable for proper operation. This can be observed easily with the sweep generator. See Fig. 6 again.

Another test is to check the separation and distortion at both 100 per cent modulation and 10 or 20 dB down from 100 per cent. There should be no appreciable change. If there is, something is wrong with the i.f. band pass.

## R.f. Adjustment

Now comes the most difficult part. It is the alignment of the r.f. section. It is understood that some of the inexpensive tuners have their front ends so made that it is about impossible to make any adjustments other than one oscillator setting and one r.f. setting. If you are fortunate enough to have a more expensive unit to align, a complete front-end procedure can be performed.

The oscillator and the r.f. sections can be adjusted at the same time, thereby cutting down the time and effort required to achieve optimum results. First, the dial pointer should be located properly so as to cover the entire dial correctly. Second, the oscillator must be adjusted at both the high and low ends of the band for proper tracking. This is easily done by using either stations of known frequencies, or a crystal controlled or calibrated generator. The oscillator trimmer is adjusted when tuning at the high end, and the coil is opened or closed when tuning the low end. The dial is set to the proper point corresponding to the frequency being checked. The oscillator adjustments are

Continued on page 32

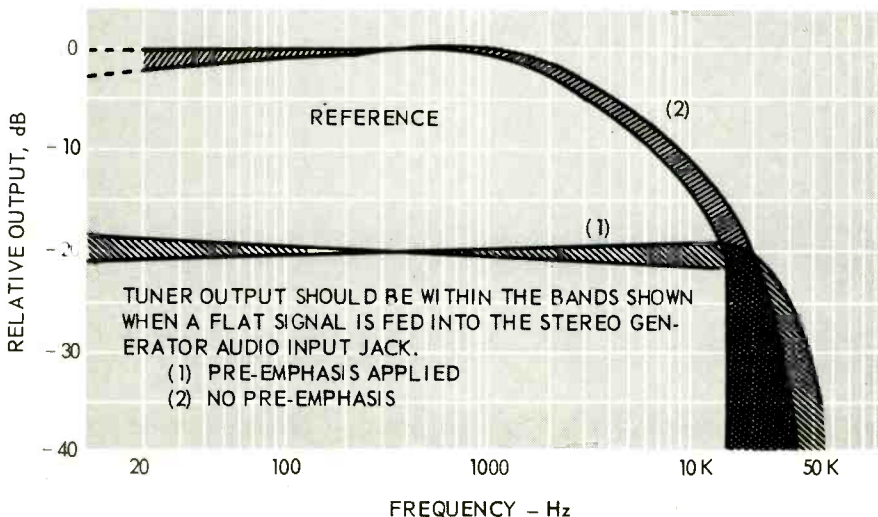


Fig. 7—Tuner response curves, showing limits.

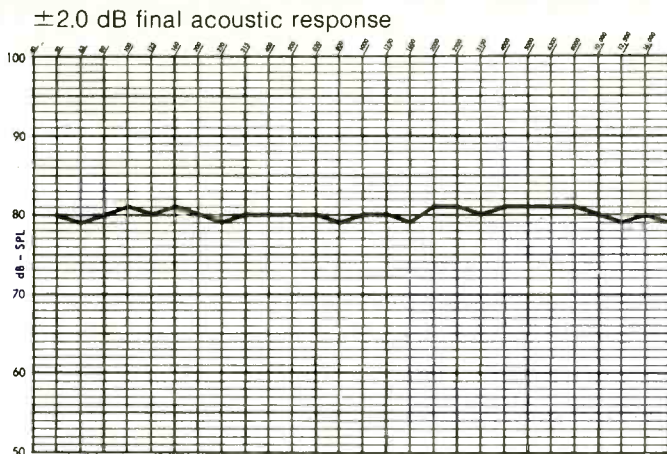
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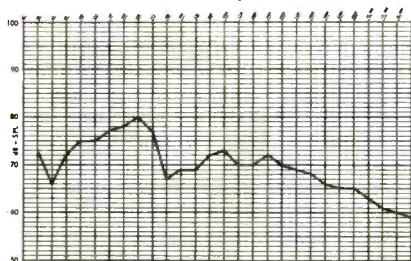
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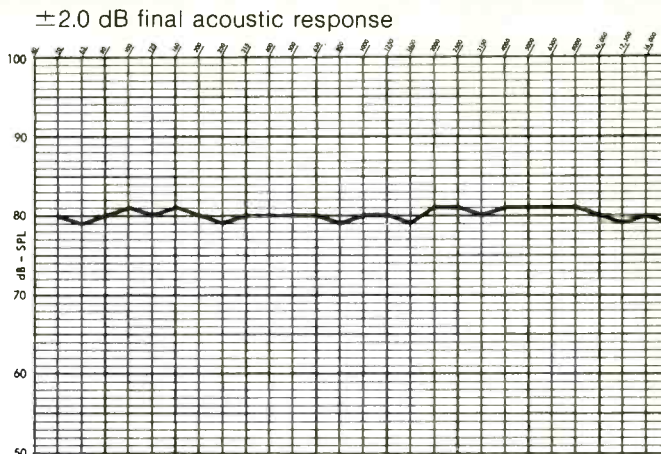


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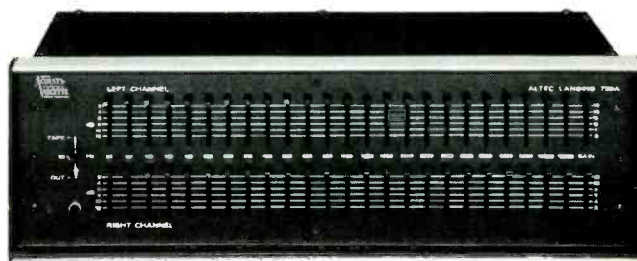


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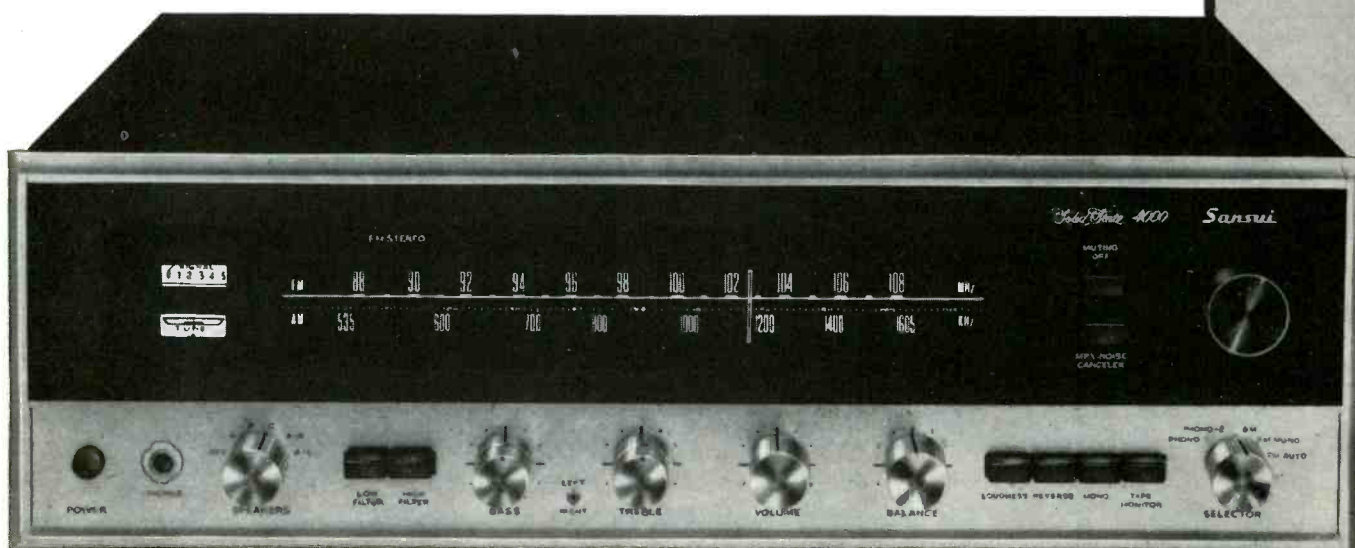
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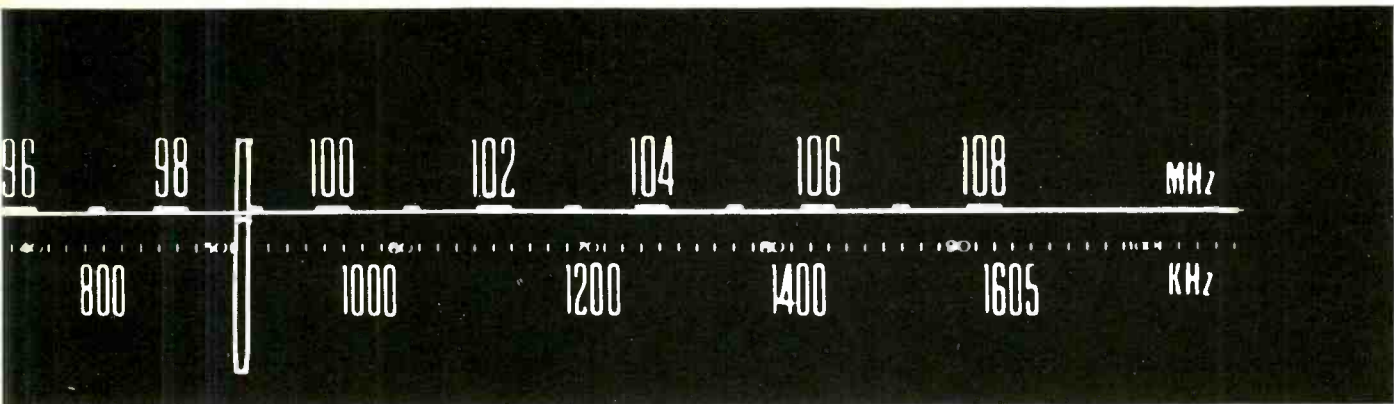


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See it, hear it and you'll know why we say that at \$349.95, the Sansui 4000 is the greatest value in its power and price range.





### ADDITIONAL FEATURES

**All silicon preamplifier** with specially designed silicon transistors for high gain and low noise characteristics.

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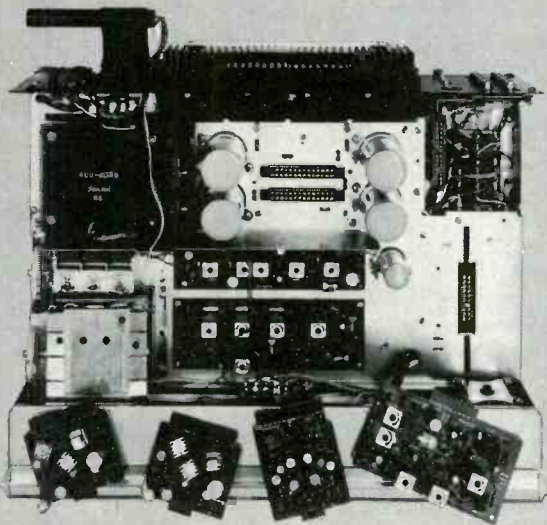
**Two phono inputs** (47K and 100K ohms) which match most cartridges.

**All silicon AM Tuner** for greatly improved AM reception.

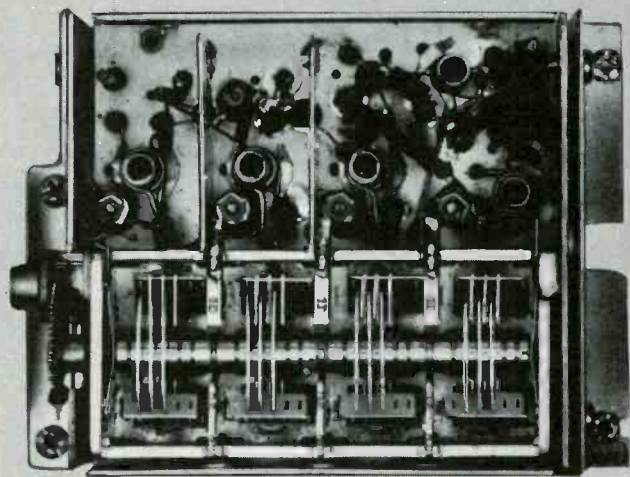
**Distortion-free tone controls** with friction coupled design.

**Black window design** that is as practical as it is attractive.

**Plus:** foolproof output terminals, two AC outlets on rear panel, high-and low-cut filters, loudness control, headphone jack, DIN connector, muting switch, stereo reverse and mono-stereo switches, noiseless push button switches, speaker selector indicator, protector indicator, heavy fly-wheel for easy tuning, and much, much more.



Sansui 4000's new printed circuit design features separate P. C. modules with plug-in multi-connectors for FM MPX, preamplifier and driver amplifiers, permitting faster more economical servicing.



**ALL NEW FM PACK** with FET, noiseless silicon transistors in the 2nd RF mixer and oscillator stages for the highest sensitivity and selectivity. Newly designed integrated circuits in the four IF amplifiers give the Sansui 4000 outstanding stability and IF rejection.



REAR VIEW  
SANSUI 4000

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## ■ Stereo Tuner

Continued from page 28

then made so that the tuner responds to the indicated frequency. To check the r.f. section(s), use the same signals as for the oscillator tracking.

Insert a tuning wand (such as General Cement's tool #8278) through one of the r.f. tuning coils, or as close as you can get to it. Note the resultant meter swing. If it goes down, try the other end of the tuning wand. This will detune the coil in the opposite direction. If the deflection is down by the *same* amount as previously, the coil is *center* tuned. Any other indication is one of mis-tuning.

The iron in one end of the tool increases the inductance of the coil into which it is inserted, and the brass end decreases it. Closing the coil will *increase* its inductance, thus tuning it to a lower frequency, while opening it will *decrease* its inductance, tuning it to a higher frequency.

The tuning-wand test is used to check the r.f. tuning at both the high and low end of the band. As with the oscillator, the trimmers adjust the high end and

opening or closing the coils, (tuning them) adjusts the low end. So if you get an increased meter indication, or AGC voltage, when inserting the brass end, open the coil to decrease its inductance (low-frequency end), or decrease the capacitance (high-frequency end). Conversely, if the iron end increases the reading, close the coil to increase its inductance, (l-f end), or increase the capacitance (h-f end).

I have found only one tuner so far that used screw adjustments for the coils that prevented using the tuning wand. The only solution was to note the screw slot position and then carefully rock the screw back and forth while looking for the maximum output. Several repeats will have to be performed at both the high and low ends of the band in order to achieve optimum results, i.e. no further improvement.

Having the cover on the r.f. housing is even more important for these adjustments than having the bottom plate on the tuner for the i.f. adjustments. Use the alignment holes provided. If none is available, remove the plate and drill them. Fortu-

nately, a hole large enough to admit a tuning wand will not adversely affect the performance of the tuner.

On inexpensive units, you can sometimes improve the results by relocating the dial pointer and resetting the oscillator trimmer. You will have to keep track of the amount of AGC voltage you can get on some given station at the low end of the dial. The object is to try to move the high end around (with the help of the adjustments, and resetting the dial pointer accordingly), so that a better low end might be achieved.

One note of warning. *Don't try to improve upon the adjustments once you have achieved what is wanted.* The inevitable result is that the attempt to improve soon causes a complete loss of whatever was obtained, and you must start over again searching for the desired setting of adjustments. This rule holds true for every section of the tuner, r.f., i.f., and stereo decoder.

Now you have the story on how to go about tuner alignment. You need only add a large measure of patience and your attempts will be successful, Good Luck!  $\text{AE}$

### TEST CHART

Item	MPX Gen	Tuner	Results
1	Mono	Mono	400-Hz distortion should be less than 1 per cent
2	Stereo (center ch.)	Mono	400-Hz distortion should be less than 1.5 per cent
3	Mono		400-Hz distortion should be less than 1.5 per cent
4	Stereo Left Center Right	Stereo Left L, R Right	400-Hz distortion should be less than 1.5 per cent, and should be the same for all conditions
5	Stereo, 19 kHz off	Stereo L, or R	Non-sync. should be low freq.
6	Mono	Mono	L & R outputs within 0.1 dB
7	Mono	Stereo	"
8	Stereo, Center	Stereo	"
9	Stereo-L, R	Stereo	"
10	Stereo-L, R	Stereo	Separation should be at least 35 dB
11	Stereo, no mod (only 19 kHz sync)	Stereo	19 kHz and 38 kHz should be at least 35 dB down

All distortion figures are based on the assumption that the tuner has at least 45 dB S/N for internal noise, and is capable of providing at least 35 dB of separation.



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# Equipment Profiles

- Tandberg 6000 Tape Deck 34
- Sherwood SEL-200 Receiver 38
- Advent Speaker System 45

## Tandberg 6000 Series Tape Deck



### MANUFACTURER'S SPECIFICATIONS:

**Maximum reel size:** 7 in. **Speeds:** 7½, 3¾, and 1⅞ ips. **Heads:** Erase, Record, Playback, and Crossfield Bias. **Motor:** Hysteresis-synchronous. **Erase and Bias Frequency:** 85.5 kHz. **Inputs:** Mic, Line, Phono (magnetic or ceramic). **Frequency Response:** 7½, 40-20,000±2 dB; 3¾, 40-16,000±2 dB; 1⅞, 40-9000±2 dB. **Wow and Flutter:** .07% at 7½; 0.14% at 3¾; 0.28% at 1⅞. **Signal-to Noise Ratio:** 54 dB, unweighted. **Dimensions:** 15½" L, 12¾" D, 6½" H. **Weight:** 21 lbs. **Price:** \$499.00

It seems as though every new product from any of the reputable manufacturers has more new features than the previous model, as would be expected. Similarly, performance also seems to get better with each new model. Such is the case with the Tandberg 6000, which continues the use of crossfield biasing, provides meters, allows for direct recording from a phono cartridge, as well as from microphone or

line sources, includes a limiter, and for the first time incorporates a pushbutton start facility, and permits making sound-on-sound, "add-a-track," and echo recordings.

The control panel is complete on the lower portion of the deck, assuming it is used in the vertical position. At the left are the two record-level meters, illuminated during recording. Below are the dual concentric record-level controls, with a switch lever protruding through the panel to permit selection of line or phono for the lower control, while the upper control knob serves for the microphone. Next to the right are two phono jacks for microphone inputs.

Six switches follow in the progression across the control panel. The first is a push-push LIMITER switch, followed by the left and right RECORD buttons, which lock when the tape motion lever is placed in the run position, and release when the machine is stopped by the tape motion lever, though not by the START/STOP but-

ton, about which you will learn later. The two push-push playback buttons follow—in the depressed position, you monitor from the tape; undepressed, from the source. Next comes the dual-concentric playback level control, followed by a switch lever moving in an arc around the playback level control, and having three positions—AB TEST, NORMAL, and s ON s. In the AB TEST position, one can monitor from one channel and sing along with the program into the microphone, recording the mixed new program on the other channel—the usual sound-with-sound procedure. In the s ON s position, one can reproduce one channel and record on the other, with no cross feeding. The NORMAL position is used when no special effect is desired—the conventional two-channel recording operation. Next to the right is the stereo headphone jack.

Above is the usual Tandberg tape motion control lever, in the familiar "T" configuration, except that it also has a position upward which frees the reels from each other for ease in threading. Above this lever is the four-digit counter, and to its right the counter reset button and the a.c. power push-push switch.

The speed control is at the top of the panel, and it moves the idler mechanically to change speeds, and simultaneously switches the record and play equalization in the two channels at the same time.

The START/STOP button, also a push-push switch, energizes a solenoid which operates as a pause control. Once the tape-motion lever is operated, the tape is started or stopped by operating the button—a particularly desirable improvement.

All connections to the recorder except microphone inputs and headphone output are made on the rear panel—or the top, if the machine is used in the vertical position. There is a four-terminal socket for a remote foot control, which parallels the STOP/START button in effect. There is an outlet for external equipment, such as the FM-MX filter which requires a 26-V d.c. supply, and which filters out the pilot and the 38-kHz switching frequency from those receivers or tuners which do



It's kind of a dumb-looking thing, but the ear is still the best listening device around. Which should tell you something about the shape of a Yamaha speaker.

True, the ear receives sound and a speaker reproduces it. But the basic principles of physics and design are essentially the same. There is a place in the middle through which the sound travels. Surrounding it are planes of

varying dimensions. There is no symmetry.

This is because sound is not symmetrical. It bends. So symmetrical shapes—ears or speakers—will confine sound to an area that won't let it bend naturally. (Cup your ear and see how directional and different things sound.)

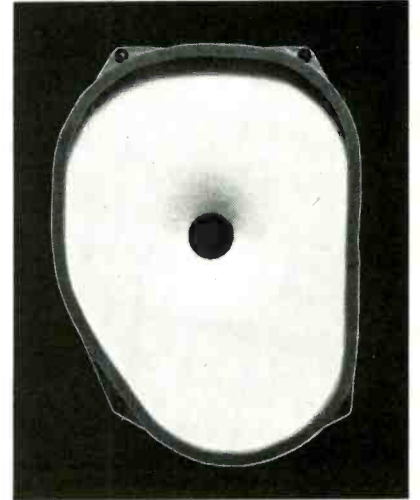
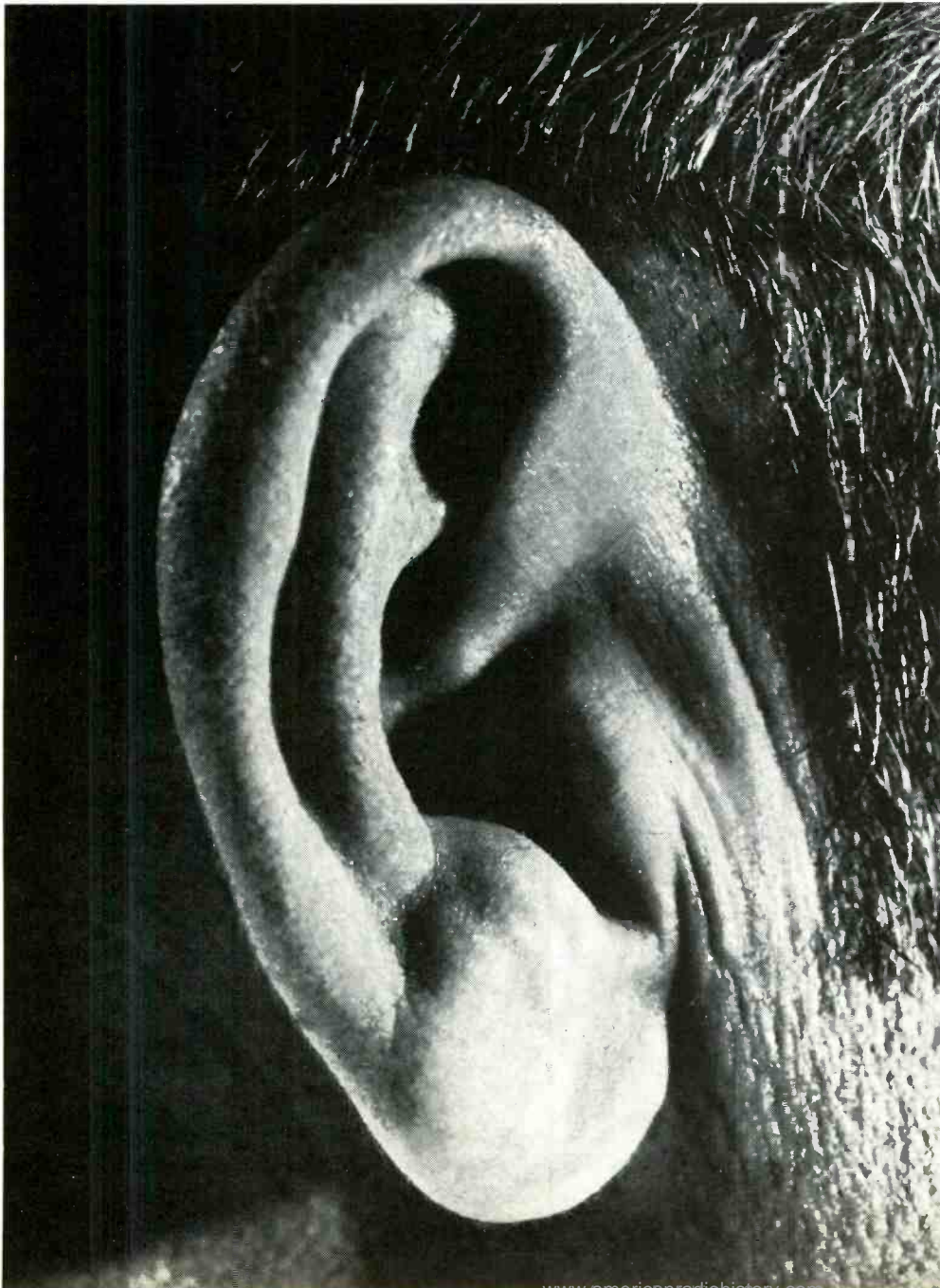
The irregular shape of a Yamaha speaker gives sound waves of different length a place to go. Long waves go to the long parts, medium

waves to the medium parts and so on.

The result is a sound as close to natural as you've heard. Freer, fuller, more omnidirectional.

Listen to what natural sound is all about. If you're not convinced then, well, maybe you *are* wearing the wrong kind of ears.

**Either we're right  
about the shape of our speakers,  
or you're wearing the wrong kind of ears.**



 **YAMAHA**

YAMAHA INTERNATIONAL CORP. Audio Products Division  
7733 Telegraph Road, Montebello, Calif. 90640

not have sufficient internal filtering, which is a rarity in modern equipment, of course. The filter is available as an accessory when required.

In addition, there are three "DIN" sockets for direct connection to receivers or amplifiers so equipped—one for recording or playback from the radio or amplifier, one for connection to magnetic, ceramic, or crystal pickups (with a separate switch for selection of type of pickup), and one for output to connect to another tape recorder for copying. There are also three pairs of phono receptacles for line or pickup inputs and for the line outputs, as well as a seventh phono receptacle for a derived center-channel output. Four large "buttons" serve to wrap the power cord around, and a sliding cover fits over the panel to obscure the cables and connections when the machine is used in the vertical position.

### The Circuits

The phono selector switch introduces sufficient attenuation in the ceramic/crystal position to match the inputs to a certain extent, while the LINE/PHONO switch on the front panel changes the gain and equalization of the three-transistor preamplifier section. This section is followed by the limiter, which consists of three bipolar transistors and an FET. When switched in, the limiter will give the same output, within 2 dB, over a 40-dB range of input levels, albeit with some increase in distortion. The waveform begins to square off as level is increased, unfortunately, although it does prevent large overloads. The limiter is followed by the three-transistor booster, which feeds the equalized recording amplifier, also utilizing three transistors. Two additional transistors serve to drive the indicator meters, and three more serve as a playback amplifier, followed by three pairs of transistors in playback boosters—one for each channel and one for the derived center channel. Five more transistors are used for the oscillator, three more in the power supply, and one in the START/STOP circuit—a total of 57 transistors (of which two are FET's), 14 diodes, and 3 Zeners. In all, it is a well-designed, conservative circuit which performs well.

### Performance

The ultimate test of any tape recorder is in how it performs—frequency response, wow and flutter, and signal-to-noise ratio. The frequency response from standard tapes at 7½ and 3¾ ips is shown in Fig. 3 in the top two curves, while the next three show the response in and out at all three speeds. The bottom curve shows

the deviation from RIAA response from a magnetic cartridge playing the CBS STR-130 test record. A wow-and-flutter measurement resulted in a percentage of .05 at 7½ ips, .09 at 3¾, and 0.15 at 1%, (most of it being in the range from 6 to 250 Hz), all of which are excellent measurements. Hum-and-noise was 54 dB below the 3 per cent distortion point, which was measured at +3.5 dB referred to the indicated zero level on the meters.

At the 0 level, distortion measured 2.3 per cent, with all these measurements being made at 1000 Hz. At 10,000 Hz, and again at 0 recording level, distortion was 0.75 per cent; at 5000, 1.30, and at 100 Hz it was 2.50 per cent.

The input signals required for 0 recording level were measured as .02 mV at the microphone inputs, 4.0 mV at the line inputs, and 1 mV at the magnetic phono input. The same recording level

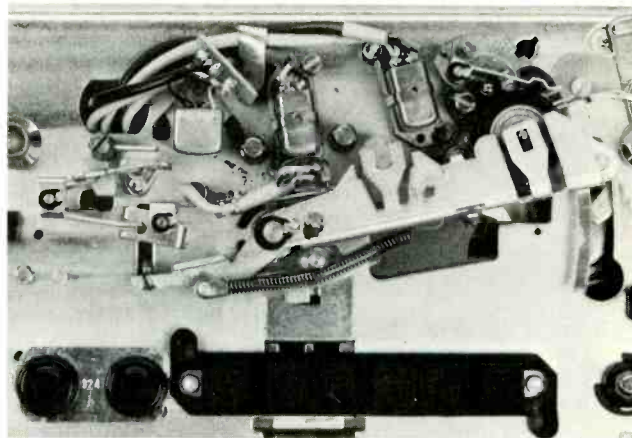


Fig. 1—Showing heads and capstan.

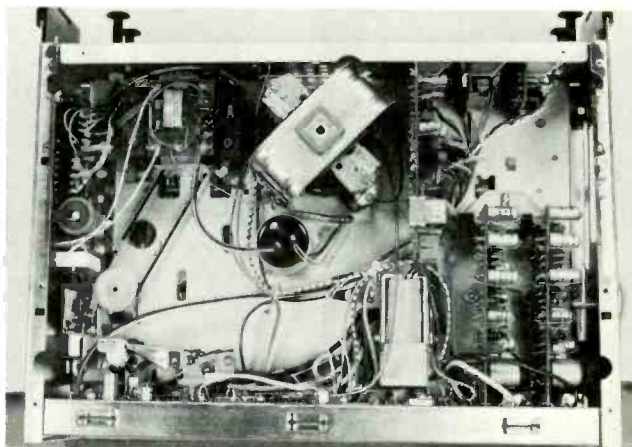


Fig. 2—Underneath view.

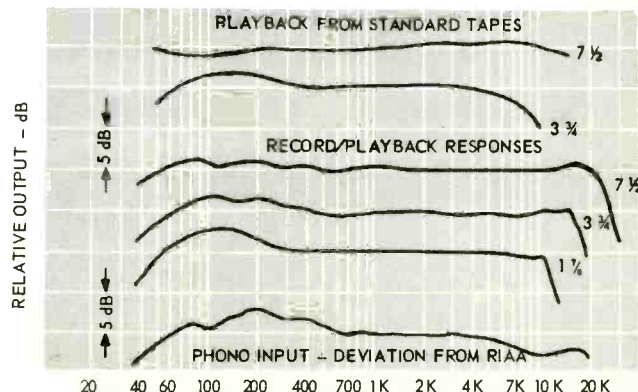


Fig. 3—Frequency response curves.



# The independent test labs think as highly of the Dual 1219 as we do.

No surprise. Because with every Dual tested, every performance claim we've ever made has been confirmed by independent test labs. With no exceptions.

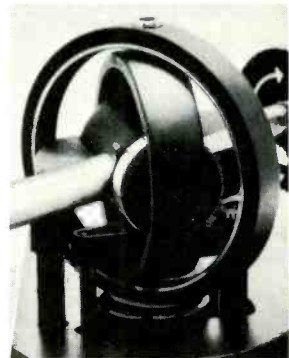
Four years ago, for example, we introduced our 1019. Audio experts rated it the finest automatic turntable ever made. But we were already hard at work on what was to become the Dual 1219.



"anti-skating... reduced wear on the record grooves..."  
Audio

Is it the worthy successor to the 1019 we believed it would be? Stereo Review says it is.

"The 1219 is a good illustration of how an already superior product (the 1019) can be further improved by intelligent and imaginative design and engineering."



"...four point gimbal-bearing system of extremely low friction."  
American Record Guide

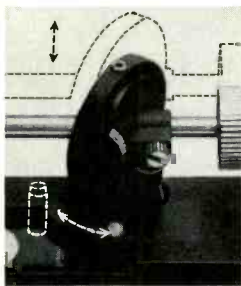
High Fidelity also agreed, with such specifics on the 1219's performance as these:

"Speed accuracy is greater (than the 1019), wow and flutter are a bit lower, tracking force and anti-skating adjustments are more precise...outstanding in all these characteristics."

As for the benefits of the 1219's gimbal-suspended 8-3/4" tonearm, The American Record Guide's results showed:

"The arm carries the cartridge in a way that permits it to extract every subtlety it possibly could from the record groove."

We actually felt the 1219 might have more precision than most people would ever need. But Audio disagreed, we're pleased to note:



"...novel adjustment for optimizing vertical tracking angle..."  
High Fidelity

"Whether or not the advantages of exact setting for vertical tracking and for anti-skating can be identified by the average listener, measurements show that there are improvements...reduction in distortion, and...reduced wear on the record grooves, particularly on the side of the groove nearest the center of the record."

Complete reprints of these test reports are yours for the asking. So is a 16-page booklet which reprints an informative Stereo Review article on turntables and tonearms.

After you look through all of this, you'll understand why most hi-fi experts have Duals in their own systems. And why every record you buy is one more reason to own the \$175 Dual 1219.



"...will have greatest appeal to those who dislike any compromise..."  
Stereo Review

United Audio Products, Inc., 120 So. Columbus Ave., Mt. Vernon, New York 10553. **Dual**

gave a line output of 0.95 V. Channel separation was identical with the hum-and-noise measurement. Fast-forward and rewind time measurements for 1800 feet of tape—Scotch 203 was used for all measurements, since the machine was labeled to indicate that low-noise tape should be used—was a mere 120 seconds, somewhat better than specifications.

Since our test tapes were only extended to 20,000 Hz, we went further at 7½ ips and made extended measurements up to 30 kHz. Response was down 4 dB at 23 kHz, down 11 dB at 26 kHz, and down

16 dB at 28 kHz, which indicates that the crossfield technique works well. The playback head gap is claimed to be 80 micro-inches (2 microns), which usually ensures excellent high-frequency response.

Without a doubt, this is the top of the line in the Tandberg tradition. This observer has always deplored the use of "magic-eye" tubes as level indicators, although we realize a good case can be made for them over meters, but we just happen to have been trained to use meters and we are familiar with their idiosyncrasies and their limitations—so we were pleased

when Tandberg switched to meters. We were also pleased when Tandberg added the "free" position to the familiar "T" slot of the tape-motion lever. Now with the addition of the solenoid and the START/STOP button, the 6000 series is apparently the best of the always reliable Tandberg line. Mechanically it is neat, with plenty of room within the case so that it is readily accessible and easy to get at for any servicing that might be necessary.

C. G. McP.

## Sherwood FM Stereo Receiver Model SEL 200



### MANUFACTURER'S SPECIFICATIONS:

**TUNER SECTION:** IHF Sensitivity: 1.5  $\mu$ V. S/N: 70 dB. Capture Ratio: 1.7 dB. THD (Mono): 0.15%. Selectivity (Alternate Channel): 70 dB. Image Rejection: 80 dB. I.f. Rejection: 110 dB. Spurious Response: -100 dB. Stereo Separation: 40 dB @ 1 kHz.

**AMPLIFIER SECTION:** Power Output: 140 watts total IHF music power, 8-ohm load. RMS Power Output/Channel: 60 watts, 8-ohm load. THD: 0.2% at rated output. Power Bandwidth: 8 Hz to 35 kHz at 1% THD. Hum and Noise: (IHF): High Level Input: 80 dB. Phono: 65 dB. IM Distortion: 0.6% at rated output, 8-ohm load. Input Sensitivity: Phono: (variable) 1.6 mV to 7.2 mV. Tape Monitor and Aux: 200 mV. Frequency Response: Aux: 20 to 20 kHz  $\pm$ 1 dB. Phono: RIAA  $\pm$ 1.5 dB. Damping Factor: 40 at 8-ohm load.

**GENERAL:** Power Requirements: 115-125 V, 60 Hz, 30 to 300 watts. Cabinet: Oiled Walnut (included). Size: 19½" w. x 6¼" h. x 14" d. Suggested retail price: \$599.00

Sherwood Electronic Laboratories ships their new SEL-200 Stereo FM Receiver with one of those familiar "fact-tags" attached, by a bit of string, to one of the control knobs. The front of the tag proclaims, in bold type, "Our Finest Receiver," and, after putting this rugged machine through our extensive tests and

equally extensive auditioning period, we are inclined to agree with the statement. In addition to long-recognized virtues and features, this receiver includes a few that are rarely seen on an integrated receiver, let alone separate tuners and amplifiers. In examining the heavy extruded gold and black front panel we were struck by the extremely well organized controls which, somehow, make this 19-inch-wide panel look smaller than it really is. The dark portion of the panel contains an expanded slide-rule dial which, because of its accuracy of calibration, provides no less than 5 calibration lines between every "MHz" from 88 to 108. What a pleasure to be able to set the pointer to 103.7 instead of "somewhere between 102 and 104" and to know that you are, in fact, tuned to 103.7. With this kind of marking, the serious user doesn't need a linearly divided logging scale which, in fact, this unit does not possess.

Above the left section of the dial calibration are two meters: one for zero-center tuning, the other for signal-strength indications. Why two meters? Because the zero-center one should be used for accurate center-of-channel tuning while the peak-reading meter is more useful for antenna orientation (for strongest signal). Unless r.f. and i.f. alignment are near perfect, most manufacturers are re-

luctant to supply both these meters since zero-center indication on the one does not always correspond with peak reading on the other as it should (and *does* in the case of the Sherwood SEL-200). Four colored lights are spaced above the remainder of the dial calibration area. These indicate stereo or mono broadcasts; and phono or Aux operation. Alongside the dial area are three massive solid turned-metal knobs. The tuning knob is coupled to a most effective flywheel. The Selector knob chooses PHONO, FM, or AUX program source and the Loudness knob sets desired level and also turns power on and off. The loudness control is calibrated in dB, from +8 to -60. While no mention is made anywhere of what "0" dB reference corresponds to, the markings are useful in utilizing the loudness-contour feature and in allowing easy resetability, once desired listening levels have been determined by the user.

The lower section of the panel contains a series of smaller control knobs, two banks of push buttons (all of the push-to-make/push-to-disengage type), record out and monitor jacks (which parallel their counterparts on the rear panel, should a visiting tape recordist want to record from, or play through your system without having to get around to the back of your equipment cabinet) and the usual stereo headphone jack. A tiny knob at the extreme left of the panel is a "dimmer" control for front panel illumination. The mode switch knob offers STEREO, CHANNEL 1 (to both speakers), CHANNEL 2 (to both speakers) and MONO positions. Bass and treble control knobs provide tone compensation for both channels simultaneously and the balance control performs its usual function. The first bank of push-buttons includes an FM mute-control switch (which Sherwood prefers to call a "hush" control), a high-frequency cut-off filter, tape monitor switch, loudness-contour on/off switch and a "stereo only" switch. The latter button is an interesting, though not totally original



When you know what it takes to make a TEAC, you know why professional people wax lyrical about our A-7030.

This is a no-nonsense pro-quality tape deck, with unrivalled sound reproduction at 15 or 7½ ips. A-streamlined solenoid control system for effortless operation. A system that makes cueing as easy as pushing a button. Automatic rewind and shutoff for built-in convenience.

The A-7030 is the sum of many systems, and the sum of our savvy in producing them. It's the head of our whole fine family of tape decks.

So if somebody wants to write a sonnet on it, we've got a great line for them.



## SOUNDS LIKE POETRY TO THE PROS.

TEAC

TEAC

### A-7030

- Dual-speed hysteresis-synchronous motor for capstan drive
- Two heavy duty 6-pole capacitor-start induction motors for reel drive
- Tape tension adjustment
- Massive inertial flywheel, over 1½ pounds
- Instant off-the-tape monitoring without interruption of recording
- Sound-on-sound and echo with simple external connections
- Built-in mike-line mixer
- Stainless steel panel reinforced with 13/64" aluminum base plate for assured stable performance

## TEAC

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innovation. In the early days of stereo FM, a few manufacturers offered a switch setting which allowed *only* stereo FM broadcasts to be heard as you tuned across the FM dial. With so few stations broadcasting in stereo in those days, users became confused, thinking there was something wrong with the equipment. Today, with the dial literally "teeming" with stereo FM stations, it is nice to see this refinement restored by Sherwood.

The second bank of push-buttons activates main or remote speakers as well as a mono speaker connection, about which more in a moment. With all speaker buttons released, the stereophone user may listen in silence, via phones only. A front view of the receiver is shown in Fig. 1.

The rear panel contains the requisite number of input and record jacks at the left, above, the antenna terminal strip which is wired to accept 75- or 300-ohm transmission line. A grounding terminal is located in this vicinity for connection to other equipment. A three-position phono-sensitivity switch follows, enabling the user to adjust phono gain to match FM levels regardless of the cartridge he chooses. Remote and main speaker terminal strips follow.

One switched and one unswitched convenience a.c. receptacles are provided, flanking the 4-ampere line fuse. A "mono" speaker terminal strip allows connection of a single speaker system to which will be fed the sum of left-channel and right-channel program material. Such a third speaker might be used as a "fill" for widely spaced stereo speaker systems, or, as a complete (albeit mono) listening set-up in a third location besides the main and remote stereo locations. Just below this terminal strip is a "hush adjust" control which permits the user to adjust mute threshold level.

Structurally, the Sherwood SEL-200 is more reminiscent of professional or industrial equipment than of a "consumer" item. Chassis layout is faultless, and extra reinforcing braces and angles make it virtually impervious to deformation of any kind. The chassis is built to withstand the hazards of long-distance shipping via even the most thoughtless carrier! All circuit modules (and there are seven) are mounted securely in a manner which precludes the possibility of cracking and, as further proof of the reliability of this receiver, the printed circuits are built on a fibre-glass base material—the most costly, but the most dependable base material that can be used for printed circuitry. A totally shielded FM r.f. section constitutes an eighth "module," as can be seen in the top and bottom views of Fig. 2. We examined the components used in this

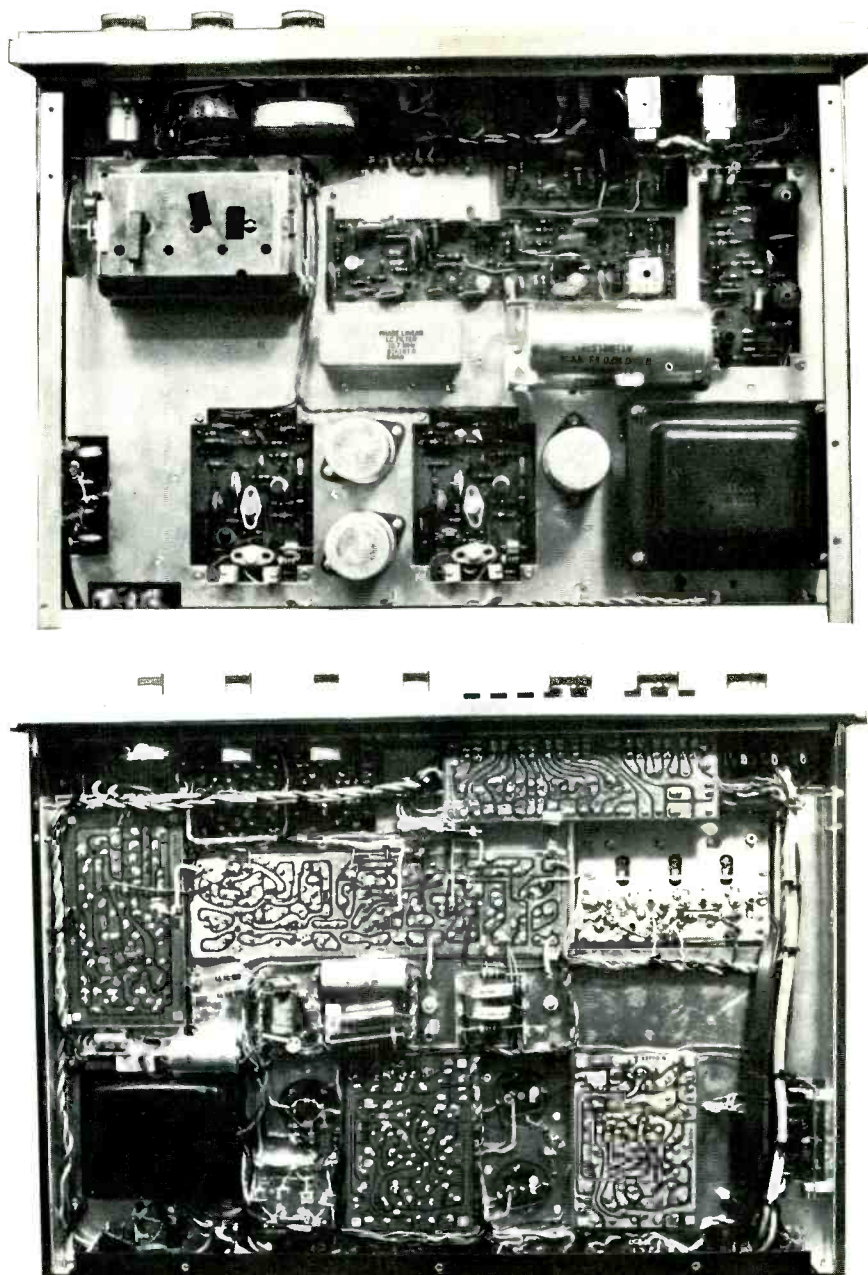


Fig. 2—Top and bottom chassis views

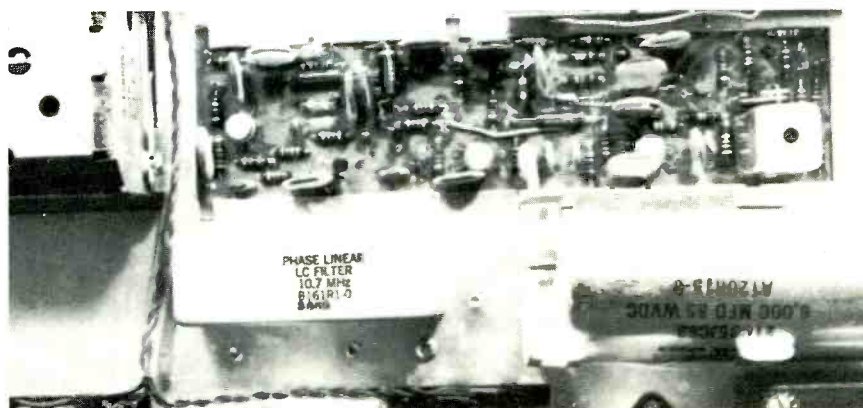


Fig. 3—Detailed view of FM section shows sealed phase-linear toroidal Butterworth band-pass filters. Only tunable item on I.F. strip is detector transformer at extreme right.

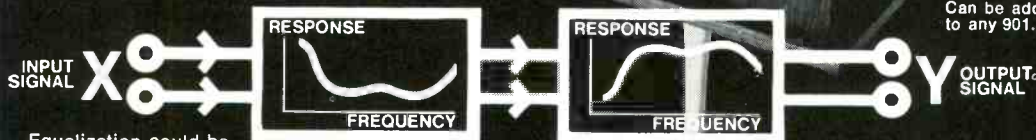


# Why doesn't every speaker system have an EQUALIZER?

If you have heard the BOSE DIRECT/REFLECTING™ speaker system, or if you have read the unprecedented series of rave reviews in the high fidelity magazines, you already know that the 901 is the longest step forward in speaker design in perhaps two decades. The superiority of the 901 derives from an *interralated group of advances* (covered by patent rights issued and pending) that are the result of a 12-year intensive research program on sound reproduction. In each issue we discuss one aspect of this research, with the hope that you will be as interested to learn about these new concepts as we were in developing them. In this issue we examine EQUALIZATION.

The principle of equalization is depicted in the accompanying block diagram. An input signal X passes first through an equalizer and then component S (a speaker, for example) to reach the output Y. Component S is said to be equalized when the response of the equalizer is complementary to that of component S, to create the desired uniform response of the overall system from input X to output Y. When we consider that this concept is used throughout engineering from (all) phonographs and tape recorders to complicated television and communication systems, we naturally wonder why every speaker doesn't have an equalizer.

## CONCEPT OF EQUALIZATION

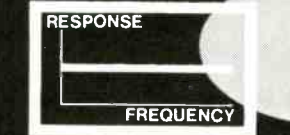


Equalization could be used to provide some improvements in conventional speakers.

But the results would fall far short of realizing the full potential of equalization. The possible benefits would be restricted, even negated, by a number of practical constraints. There would be a high probability of introducing more sound coloration than was removed.

### PROBLEMS IN EQUALIZATION OF CONVENTIONAL SPEAKERS

1. Any mechanically vibrating membrane manifests many irregularities (normal modes) which are individually too complex to equalize.\*
2. No satisfactory solution has ever been obtained for the equalization of a speaker system over the crossover region where two speakers of grossly different amplitude, phase and spatial radiation characteristics are attempting to make an acoustical transition.



### OVERALL RESPONSE FROM X TO Y OF EQUALIZED SYSTEM

3. The fundamental resonance of conventional speakers lies in a low frequency range (below 100 Hz) for which the ear is very critical of both amplitude and phase irregularities. Despite many attempts over the past decades, no really successful solutions have been found for the equalization of conventional speakers through the frequency range of their fundamental resonance.

We can now ask: HOW DOES THE 901 USE THE FULL POTENTIAL OF EQUALIZATION?

1. By using a large number of *acoustically coupled* full-range speakers, we take advantage of 'resonance-splitting' (See our issue on RESONANCES). Equalization is required for only the smooth average curve rather than for the complicated individual speaker characteristics.
2. The crossover problem is eliminated by the use of nine full-range speakers.
3. In the 901, the fundamental resonance is designed upward to near 200 Hz in order to

Walnut grille modification extra. Can be added to any 901.

obtain the smoothest possible phase and amplitude response (ideal for equalization) in the critical region below 200 Hz (See our issue on BASS).

If you'd like to hear what equalization can mean in sheer clarity and smoothness of response, along with a number of other major (audible) improvements, ask your franchised BOSE dealer for an

A-B comparison of the 901 with the best conventional speakers — *regardless of their size or price.*

\*See 'ON THE DESIGN, MEASUREMENT AND EVALUATION OF LOUDSPEAKERS', Dr. A. G. Bose, a paper presented at the 1968 convention of the Audio Engineering Society. Copies of the complete paper are available from the Bose Corp. for fifty cents.

You can hear the difference now.

THE **BOSE** CORP.®

East Natick Industrial Park, Natick, Massachusetts 01760

receiver and could find none but those manufactured by some of the most highly respected names in electronic component manufacture. Our conclusion was that Sherwood will not lose money in backing up its *three-year parts AND LABOR* warranty.

The excellent selectivity of the Sherwood SEL-200 is due, in great part, to the unique design embodied in the 10.7 MHz i.f. section, a close-up of which is shown in Fig. 3. Note that the i.f. module itself contains only one conventional "transformer" at the extreme right end of the board, and that is the detector transformer. Just below the left end of the module is a sealed multi-element phase-linear toroidal Butterworth type i.f. filter having 9-pole selectivity. Besides being "permanently aligned," this filter is absolutely symmetrical. The i.f. selectivity curve is flat within about 2 dB at 100 kHz removed from center frequency, and is 30 dB down 200 kHz away from desired 10.7-MHz center frequency. At 400 kHz away from center (the point which determines alternate-channel selectivity), attenuation is in excess of 70 dB. No conventional i.f. transformer arrangement could duplicate this response and few, if any, crystal or ceramic filters we have run across do as well either.

Other measurements associated with the FM performance of the Sherwood SEL-200 are equally impressive. As disclosed in Fig. 4, IHF sensitivity is exactly  $1.5 \mu\text{V}$ , as claimed. This excellent figure is maintained across the entire FM band, from 88 to 108 MHz. Full limiting (1 dB) is achieved at  $1.6 \mu\text{V}$ . At  $3.5 \mu\text{V}$ , signal-to-noise ratio has already reached a very listenable 50 dB and THD (Mono) has already been reduced to approximately 0.5%—a figure considered to be excellent as the ultimate figure (measured at  $1000 \mu\text{V}$ ,) not 3.5 as was true in the case of this remarkable tuner section. As for *ultimate* performance figures, the THD gets down to an incredible 0.15% and stays there at all signal input levels above  $20 \mu\text{V}$ . Signal-to-noise ratio reaches 70 dB at  $50 \mu\text{V}$  and even goes beyond that to an ultimate value of 72 dB. The ultimate THD (0.15%) is the *best* we have recorded for *any* complete receiver and we know of only one *tuner* component that does as well!

Stereo FM separation is plotted in Fig. 5 and exceeds 40 dB from around 100 Hz to 3 kHz, and 30 dB of separation is achieved at all frequencies from 50 Hz to 10 kHz.

The amplifier section of this receiver is conservatively rated, as can be seen from the IM and THD curves of Fig. 6. At rated distortion (0.2%), we read 61 watts per channel, using an 8-ohm load. If we were to reference power output to

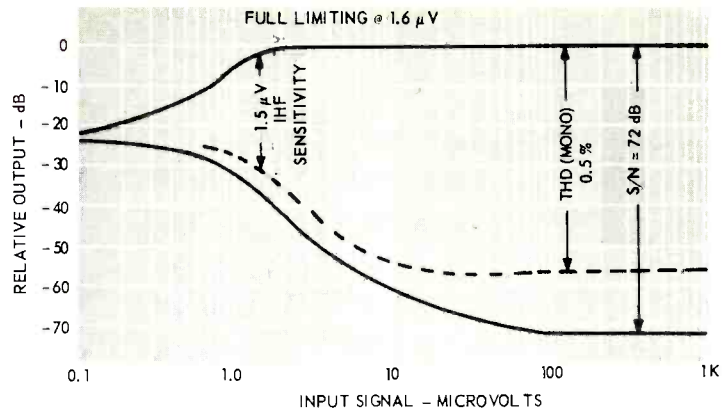


Fig. 4—FM characteristics

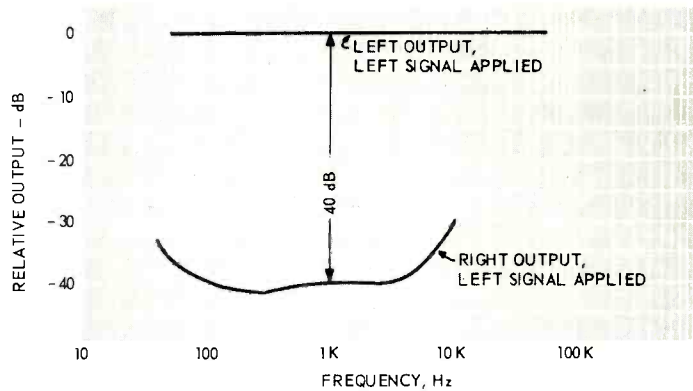


Fig. 5—Showing channel separation

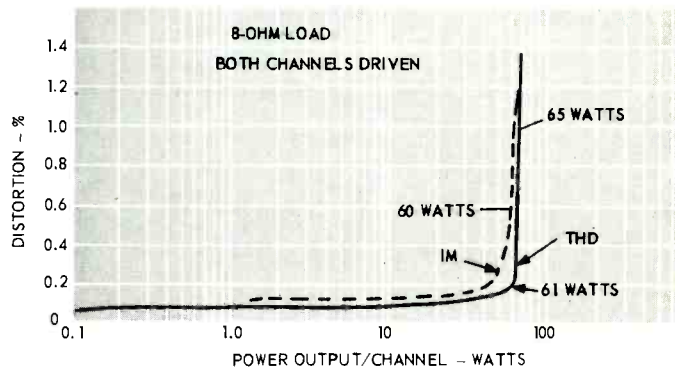


Fig. 6—IM and THD curves

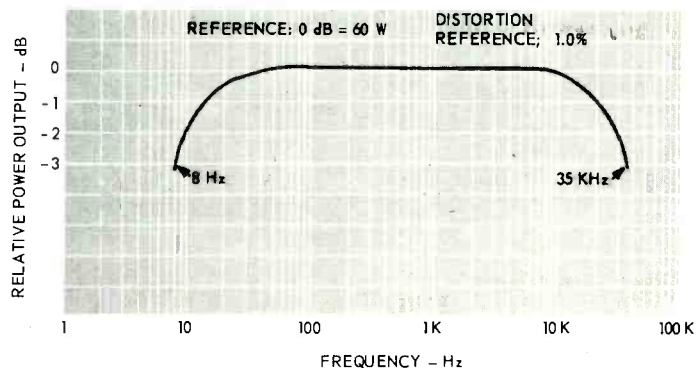
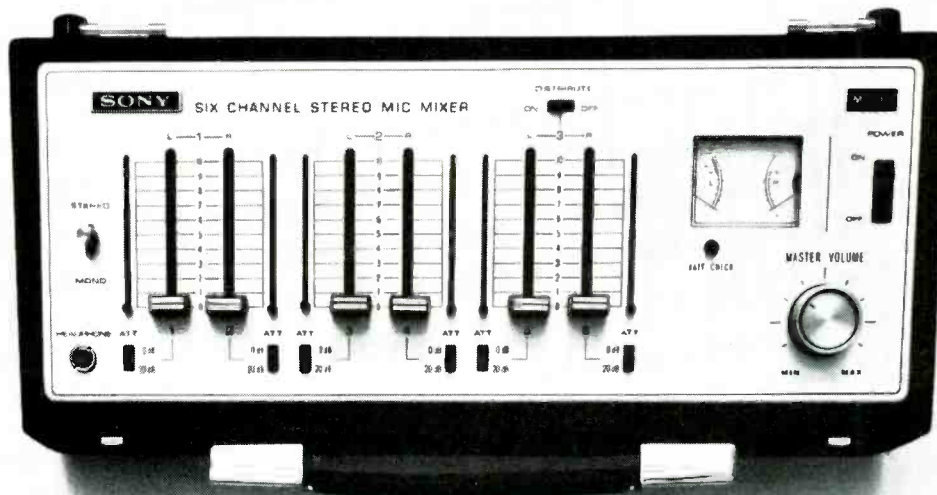


Fig. 7—Power bandwidth



# Accessories are the mother of invention.

Don't just tape it the way it is. Tape it the way you want it to be. Sony accessories give your inventiveness and imagination a chance to take off. You can mix sound, record telephone conversations, tape from one recorder to another, sing to your own accompaniment, and much more.



**1.** Start with Sony's MX-12 Stereo/Mono Mixer. Use it with any Sony solid-state tape recorder for professional mixing of up to six microphones or lines, stereo or mono. Or create sound-on-sound recordings. Priced at just \$99.50.

**2&3.** When you want to hook up one tape recorder to another, Sony adapters make the operation simple. The PC-1 Plug Adapter converts Phone Plugs to Mini Jacks and the PC-2 Plug Adapter converts Mini Plugs to Phone Jacks. Priced at just \$2.75 a pair.



**4.** Sony offers patch cords of every description, including cords for telephone pick-up, sound-on-sound, and direct recording from stereo receivers, record players, and TV sets.

**5.** Sony also offers two full-range stereo headphones for monitoring recordings, or for pleasurable private listening. Choose the Model DR-6A low-impedance headphone (8 ohms) or the DR-6C high-impedance (10K ohms) set. Just \$27.50 and \$29.50.

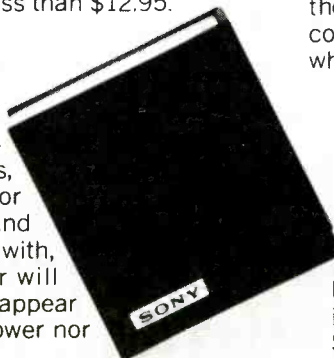
**7&8.** Two Sony accessories are designed to combat the effects of long usage, keeping your Sony tape recorder performing like new. The Sony CLH-1 Head-Cleaning Pen makes maintenance quick and easy. The high flux-density HE-2 Head Demagnetizer eliminates residual magnetism in recording heads at the flip of a switch. The Pen is just \$1.95; the Demagnetizer is less than \$12.95.



**6.** For your convenience, the Sony FS-5 Foot Switch provides remote foot-operated stop/start control for those Sony tape recorder models which do not have a built-in microphone. A stop/go mike can be plugged into the FS-5 and controlled by foot while recording.



**9.** When you add Sony accessories to Sony tape recorders, you can open your mind wide for creation and experimentation. And if you don't like what you come up with, the BE-7 Cassette Bulk Eraser will make everything on the tape disappear instantly. Requires neither AC power nor batteries. Less than \$24.95.



Look for Sony accessories in convenient new Bubble Paks now at your Sony/Superscope dealer.

**SONY SUPERSCOPE**

You never heard it so good.®

1.0% THD (as do many other manufacturers) we would have to rate this amplifier at 65 watts per channel. IM distortion reached 0.6% at an output of 60 watts, and both THD and IM decrease progressively at lower power outputs, with no tendency to rise at very low power output levels. Clipping is symmetrical when the amplifier is driven far into overload. Power bandwidth was measured using a distortion reference of 1.0% and a power output reference (0 dB) equal to 60 watts. End points are at 8 Hz and 35 kHz, as shown in Fig. 7. Tone-control range is plotted in Fig. 8, and the tone-control circuitry is of the variable-crossover feedback type. The high-frequency cut-off filter, whose response is plotted in Fig. 8, has a 12 dB per octave slope which makes it effective in reducing high-frequency noise and record scratch.

### Listening Tests

We must admit that although the Sherwood SEL-200 stands up very well when used for phonograph record and tape listening (we particularly welcomed the variable phono-input sensitivity which enabled us to equate phono and tape levels with FM level), we spent by far the major part of our listening time with the selector switch set to FM. It is the outstanding FM performance of this instrument which separates it from many of its competitors. While it is true that in our location we have logged as many listenable stations in the past (49 with indoor antenna, 58 with outdoor, fixed-orientation 4-element Yagi), listenability needs to be more closely defined to understand the excellence of the SEL-200. Our criterion has been ability to discern the program material with reasonably low distortion content and with noise level some 30 dB down or better. The amazing thing about this receiver is that every station that we were able to receive (even those that barely moved the signal-strength meter and therefore had to be of less than 5- $\mu$ V intensity) seemed to "bury" the background noise at least 45 to 50 dB below program level. The tuning action (despite the absence of AFC, which is hardly ever used these days on good tuners and receivers) "feels" as if AFC is present in that stations "pop" in and out without undergoing that "borderline" area so typical of slightly de-tuned FM sets. All indications point to the outstanding selectivity and overall i.f. characteristics discussed earlier as being responsible for this tuning ease and precision.

The Sherwood SEL-200 boasts 85 watts of power (r.m.s.) per channel when driv-

ing a 4-ohm load. Thus, with *two* sets of stereo speaker systems connected (each speaker being of the 8-ohm variety), there is fully 42.5 watts of power per speaker available—and that was more than enough for *our* four speaker systems—though all four were low-efficiency bookshelf air-suspension types. In fact, we then connected a fifth speaker for monophonic listening, just to see if that would overload the capacity of the receiver. It didn't!

The excellence of Sherwood's FM tuner products has earned that company a long-standing enviable reputation among experts over the years. Now, Sherwood has successfully combined tuner excellence with amplifier power to suit the most power-hungry listener in a product that is fully worth its price.

L. F.

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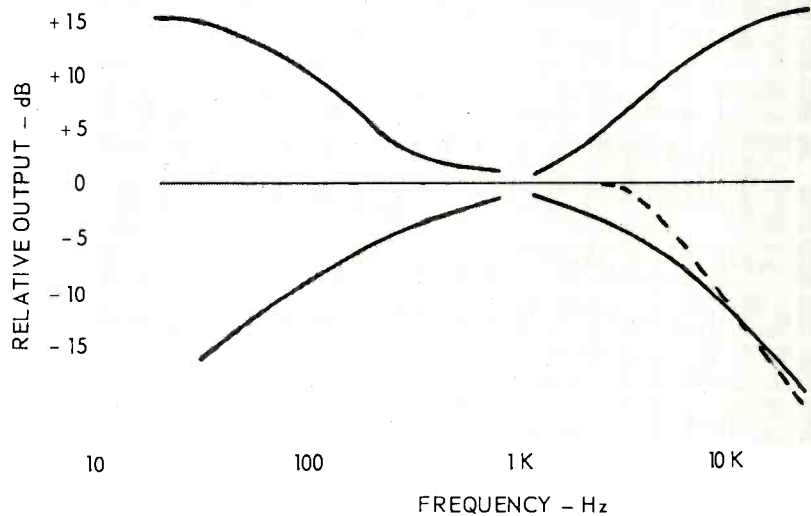


Fig. 8—Tone-control characteristics

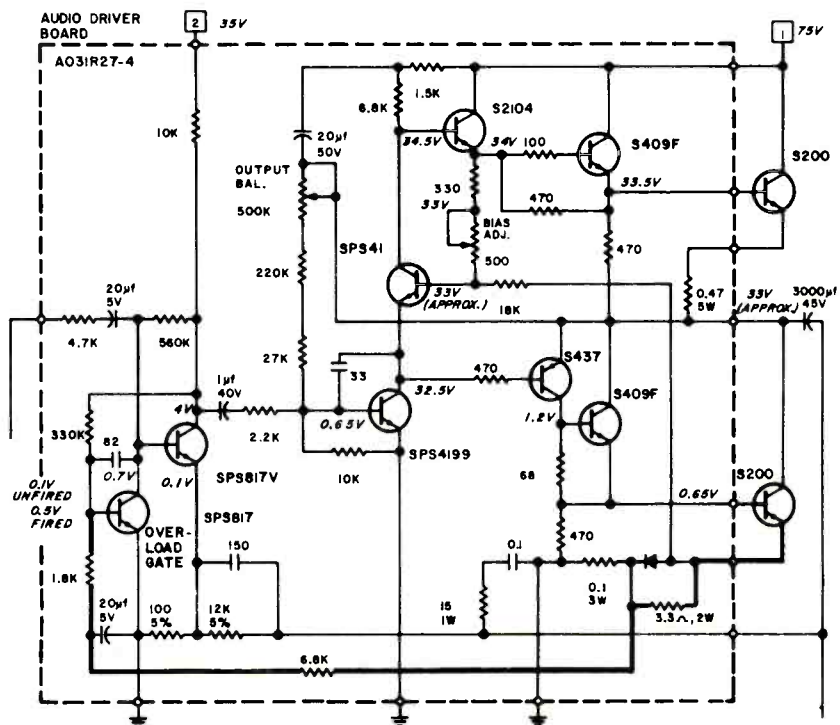


Fig. 9—Driver and output stages showing overload protection



## Advent Speaker System

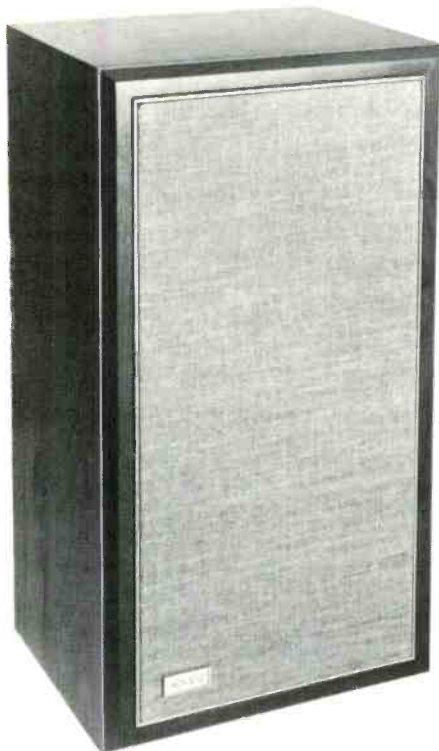


Fig. 1

Advent, a new name among hi fi products, has a long history of well known audio designs in the person of Henry Kloss behind it. Among his list of credits are the KLH Model 6 loudspeaker and the KLH Model 8 FM radio, the first home product to use active equalization to compensate for speaker shortcomings.

The new Advent loudspeaker does not represent any "breakthroughs," but is rather the highly refined product coming from years of accumulated experience. The enclosure houses a 10" woofer working on the acoustic-suspension principle, crossing over at 1000 Hz to the 2" tweeter. The woofer cone is a 7.5" piston formed by a new low-vacuum process, with high internal damping which goes a long way to eliminate "cone cry." This, incidentally, is the second low-frequency speaker to employ this new molding process—one that will probably attract more attention in the future. The annulus is of heat-formed polyurethane, permitting maximum linear cone travel at the lowest frequencies.

The 7.5" diameter of the woofer cone ensures piston action as well as good dispersion up to the crossover frequency. The treble portion of the spectrum is handled by the 2" high-frequency direct radiator. The diaphragm looks something like a 2" doughnut with a 0.75" dome in its center; the surface is coated with a lacquer-like substance to increase its radiating efficiency.

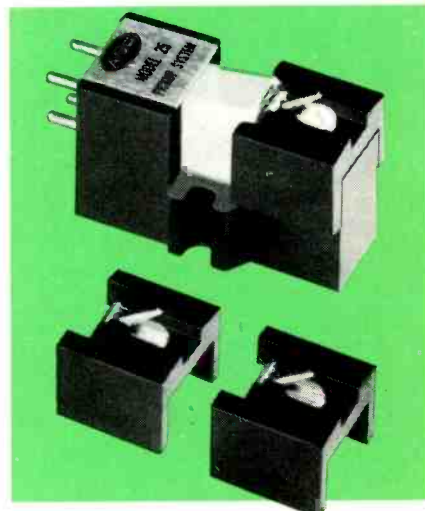
The tweeter assembly mounting is forward of the front panel. This is to prevent unwanted reflections from the front of the enclosure so as to minimize response irregularities. The grill cloth, held in place by six Velcro pads, incorporates a fine wire screen in front of the tweeter to protect it from prying fingers.

The enclosure dimensions are 25½" × 14¼" × 11½" and the unit weighs 35 pounds, still supportable by a sturdy shelf. While this is a large bookshelf speaker, its front edge molding is slightly bevelled, giving the impression of smaller size.

Amplifier connection is via knurled nuts in a recessed rectangle on the speaker's rear panel, thus making it possible to push the speaker flat against the wall. A three-position switch permits tweeter level adjustment, whose effect is shown in Fig. 2. All four sides of the enclosure are finished in oiled walnut, permitting vertical or horizontal use.

We measured frequency response, placing the speaker upright on a 2-foot-high stand, flat against the wall, tweeter control in increase position. We ran two response curves, one with the condenser microphone aimed at the geometric center of the front panel, and the other with the microphone 45 degrees off axis, both from a 3-foot distance. The test signals were 25 bands of ½ octave pink noise, fed to the speaker at a 2-volt-input level. This level produced 90 dB, SPL, 3 feet on axis. We have come to prefer this method, since it is less prone to produce the misleading peaks and dips that result with swept sinewave testing, which reflect mostly room effects and not the true loudspeaker response. The results thus obtained agreed closely with the subjective impression formed during the listening part of the test.

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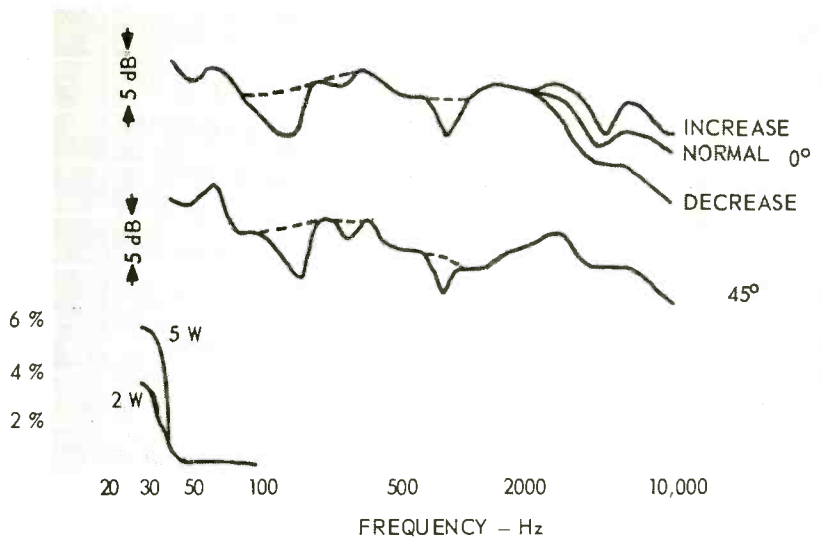


Fig. 2—The upper curve shows the on-axis frequency response with effect of tweeter level control in its three positions. Middle curve shows the 45-deg. off-axis response to the same 1/3-octave band pink noise. The lowest curve shows third-harmonic distortion at low frequencies.

As evident in Fig. 1, the frequency response was flat, with only  $\pm 3$  dB variations over the major portion of its range. What is more important is that the 45-degree off-axis response follows the on-axis response to a remarkable degree, denoting excellent high-frequency power response. While the desirability of good high-frequency dispersion is not a new idea, (Ed Villchur's article in *AUDIO* Oct. 1958), it is a goal that has, for the most part, eluded the majority of loudspeaker designers until very recently.

The low-frequency aberrations shown in the response, between 100 and 320 Hz are due to room effects. When measuring another highly regarded bass reproducer in the same position we found virtually identical response in that range.

Harmonic distortion measurements were made using a 4-volt input and the same microphone position. See Fig. 2. Above 40 Hz, third-harmonic distortion ran under 1%, with the exception of 1000 Hz, the crossover frequency, at which point distortion rose to 2.5%. With 6.5-volt input, TDH at 32 Hz was 6%. We consider this frequency to be the low limit of the speaker. 40 Hz distortion remained under 1%.

Efficiency of the Advent speaker is average for an acoustic suspension unit. 6.5 volts into a nominal impedance of 8 ohms, representing 5 watts, was enough to rattle windows with this speaker. While a good 25-watt-per-channel amplifier should be sufficient, 50 to 75 watts is not excessive.

Oscilloscope photos of tone bursts are shown in Fig. 3. They reflect, favorably, the transient response of the speaker. Since the foregoing data indicated this to be an excellent reproducer,

we looked forward to the listening session.

We played excerpts from Copland's *Rodeo*, Turn. 34169, Stravinsky's *Petrouchka*, Col. MS-6332, and Handel's *Messiah*, PHS-3-992, among others. It was gratifying to note that our ears confirmed the measured result. Particularly noteworthy is the high-frequency dispersion, resulting in excellent definition and adding spaciousness to the sound.

One could say that at twice the price the Advent speaker would be a good value, but at \$112.00 it is a bargain. An auspicious beginning indeed, for a new company.

A. R.

Check No. 42 on Reader Service Card

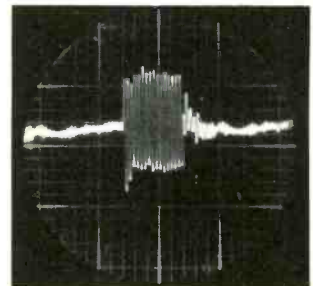
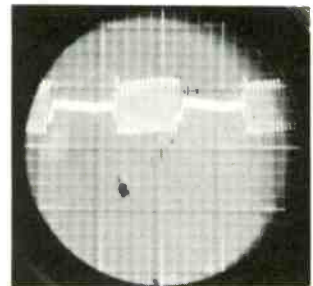


Fig. 3—Tone-burst response at 12,000 Hz and 5000 Hz.





SHERWOOD L. WEINGARTEN

**J**OHNNY MATHIS, like Ole Man River, jes' keeps rollin' along. Through a dozen musical trends, the Mathis magic has endured; though the hard rock groups seem to retain a stranglehold on the top of the charts, Mathis continues to cover hit songs and stamp them somehow with his inimitable brand. And his "Best of . . ." album still holds the record for being on the hit lists the longest—five years.

That enigmatic something that makes Mathis what he is, and keeps his fans drooling for more, is present again on his latest, Columbia's RAINDROPS KEEP FALLIN' ON MY HEAD (CS 1005). Best of all, his rendition of the Academy Award winner features an arrangement that allows the words to be understood, in contradiction to the smash B. J. Thomas version. But there are 10 other tunes done with equal success, stylistic gems that will twinkle when other artists' cuts will fade.

Mathis is not completely *out of it*, as some of his young detractors will insist. In fact, his hair is a mite too long for total Silent Majority approval, and the sideburns lend an air of rebellion to his slightly chubby face. Still, it is the basic middle-of-the-road aura that captivates his audiences, and his borrowing from all musical idioms is indicative of his wide appeal. For a while, he had turned to jazz as a backdrop for his talents, but he has returned to the multi-hued bag—always emphasizing the soft ballad groove—that brought him fame in the first place.

Included in first-side offerings are "Honey Come Back," a heavily stringed vocal that spotlights the alternate talking and choral effect; "Midnight Cowboy," which opens with a lonesome harmonica sound and then showcases strings, chorus, and Mathis' smoothness; "Watch What Happens," a cottony Muzak-type tune; "Something," which is brightened by a touch of mod-ern rhythm, and "Allie," satiny and bouncy all at once.

The flip side contains "A Man and A Woman," with excellent syncopation;

Rod McKuen's "Jean," a lilting, lovely tune; "Everybody's Talkin'," a unique rendition that somehow eliminates the country, the harshness, and the soul, and leaves only a gliding melody that lingers in the mind; Simon & Garfunkel's "Bridge Over Troubled Water," which utilizes bluesy piano and rhythm section but just misses having the power of the hit version, and "Odds and Ends," pleasantness personified.

If you didn't like Mathis' singing before now, it's unlikely that this LP will change your opinion. But if there was even a suggestion of magnetism, the attraction should build geometrically.

Another star who has weathered the everchanging musical storms is better than ever on Cotillion's BROOK BENTON TODAY (SD 9018). And the gray-haired listeners who used to comprise his fan clubs have been joined by the soul buffs and the youngsters. Witness the fantastic commercial (and artistic) success of the vinyl's lead tune, "Rainy Night in Georgia," a million-seller as a single. One of the few recent hits that deserve that status, Benton's cool version becomes a soulful ballad clad in quasi Rhythm-and-Blues style. If you haven't heard the Tony Joe White opus, listen . . . and, as Harry Golden repeatedly said, "Enjoy, Enjoy!"

Vocal backgrounds for the disk, which contains exquisite arrangements by Arif Mardin, feature the gyrations of The Sweet Inspirations. And Cissy Houston, a soul-oist on her own, adds what the liner notes call "vocal obbligatos."

Benton, whose distinctive phrasing is especially pleasing in the lower registers, shows what blues is all about when he performs "Desertion." The vocal jazz riffs only add to the mystique of the tune as the singer bemoans the fact that "it happens to somebody every minute of every day."

Other tracks worthy of attention are Paul Anka's "My Way," a 5:33 rendition that seems half that long as organ-ized soul combines with vocal background and

driving pace to construct an up-tempo excitement in ballad framework; "Can't Take My Eyes Off You," which becomes sort of a male torch song; and "I've Gotta Be Me," with Benton starting as if he's whispering in a half-sleep and ending with the listener noting that he's heard nothing like it before (despite the myriad recordings of the melody).

"Baby" is the singer's own tune. It is illuminated by heavy guitar and rhythm section, changing tempos (that at times, make it seem off balance), verbal inserts—and a lot of good stuff from the musical firm of Benton, Benton & Benton. A second original, penned jointly by the vocalist and James Shaw, is "Where Do I Go From Here?" It is country-soul, with a clippity-cloppin' flavor that insists the audiophile relax.

Esther Ofarim, an Israeli songstress who hit the charts with hubby Abi via "Cinderella-Rockafella," has a voice that is both piercing and pungent. Despite this, and despite her often coming across as a second-rate Joan Baez or Judy Collins, she can hold an audience enthralled. Proof can be found on OFARIM CONCERT (Philips, PHS 600-330), where the 14 tracks are mixed in quality but always seem to draw an enthusiastic response from the live audience.

The songstress, whose voice makes it difficult for listeners to believe she's so diminutive (at 28, she weighs less than 90 pounds), sticks mostly to traditional folk melodies. Her repertoire is large, however, thanks in part to the fact that both she and Abi speak and sing in nine languages. The concert disk, for example, features "El Vito," a duet in Spanish, and "Brahms' Lullaby" sung in German and English.

The uneven quality of the recording, both in performance and sound reproduction, is often disconcerting to the audiophile. In fact, there is often a hollowness that seems to indicate the microphones were much better placed for the audience's ears than for the taping equipment.

Still, there are enough highlights to interest folk music buffs and those who seek other contemporary sounds. Best are Donovan's poetic, lyrical "Lord of the Reedy River," "Go Tell It on the Mountain," almost a duplicate arrangement as the successful Peter, Paul, and Mary version, a souped-up rendition of "900 Miles from Home," the haunting "Frank Mills" (from "Hair"), the Lennon-McCartney composition "She's Leaving Home," and "Down By the River," the nursery rhyme (sung here in a simulated little girl's voice). Plus, of course, the bubble-gum rock success, "Cinderella-Rockafella."

Pete Seeger, middle-aged folksinger-songwriter who has weathered video blacklisting because of so-called leftist activities, continues his harangue against the hawks in Columbia's YOUNG VS. OLD (CS 9873). His own tunes lead the way with venom, "Bring Them Home" and "Ballad of the Fort Hood Three" in particular.

Also emphasized, however, is the generation gap (Seeger places himself on the side of the angels, in this case the youth). In "Poisoning the Students' Minds," for instance, he raps—with tongue in cheek—those who object to students becoming involved in politics. And "All My Children of the Sun," a poignant offering, shows in parable form that blindness to new ideas can become tragic.

Many of the tunes on the 17-track album are musically understated but lyrically overstated. Now and then the words turn into poetry, such as in the tunesmith's own "Who Knows" and "When I was Most Beautiful." And for those who are turned off by protest ballads, he performs, as no one else can, traditional items such as "Lolly Todum." Æ



### BERTRAM STANLEIGH

**Herbie Mann: Stone Flute**

**Embryo Stereo SD 520**

One of the lower points in Mr. Mann's highly variable recording career, this set features elaborate arrangements by William Fischer and Selwart Clarke for guitar, vibes, bass, drums, and string quartet with multiple overdubbings of Herbie Mann's flute. None of the wit and fresh spirit that imbue the better Mann performances has been captured in the present set. It's all rather stiff, correct, and very serious. Jazz can, of course, be serious and successful at the same time, but only when the artists are profound thinkers. Herbie Mann may be a profound technician, but he's at his best when he eschews deep thought. The

Embryo label, an offshoot of Atlantic, is a perfect reverse of everything that is so good about their new Jazz Anthology series. The full-color jacket is further enhanced by a fancy die-cut over-flap, and the space that might otherwise have carried liner notes has a photograph of a shimmering puddle.

*Performance: B*

*Sound: A*

**Erroll Garner: Concert By the Sea**

**Columbia Stereo CS 9821**

Released in mono in 1956, this set has just been reissued in simulated stereo. The recording has been one of the all-time best selling piano albums, and it is clear that Columbia has not stinted in its efforts to achieve a realistic stereo effect. On the whole, results are highly satisfactory. While the bass and drums that make up the balance of the trio are pinpointed right in the middle, Garner's piano spreads out from speaker to speaker, and his sound is bright, clean, and close up. If you don't own a copy of this fine music-making document, or if you have already worn out your old mono copy, don't let the simulated stereo label on the jacket discourage you. Everything sounds very good, indeed.

*Performance: A*

*Sound: A*

# Pioneer has the right

The Tuner connected  
to the Preamp

The Preamp connected  
to the Crossover



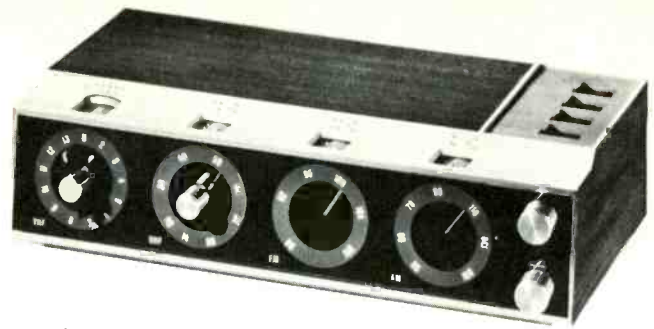


# CES 70

continued from page 8

LWE-Acoustron will be adding four more speakers to their range which now extends from \$60 right up to \$2000. . . . Star attraction will be a semi-professional cassette recorder with a frequency range from 30 Hz to 18 kHz incorporating a **dynamic noise-reduction circuit giving up to 15 dB improvement in S/N**. Three motors are used and the price will be in the region of \$350. EPI will be demonstrating an improved version of the 201 Quartet speaker system which is a medium-size floor-standing model. It uses—in effect—two Model 100's (reviewed in June) but the units face upwards and outward to give better dispersion. Price is still \$199. **Advent** will be demonstrating **Scheiber** 4-channel disks outside the Show at the St. Moritz hotel. Other 'extra-mural' exhibitors will include **RCA** who will be showing off the new 4-channel compact systems. As reported elsewhere, **RCA** are backing the 8-track format (Quad-8) for their first venture into quadraphonics and they will have at least 30 tapes available in August. **Lear-Jet** and **Motorola** are also producing equipment for 4/8 track cartridges—mainly for auto use.

One of the most interesting items from **Pioneer** is an elaborate Electronic Crossover unit (Model SF-200) which offers a choice of five crossover frequencies in the lower mid-range from 125 Hz to 1 kHz and five in the higher range up to 8 kHz. Three rates of attenuation are provided—6, 12, and 18 dB per octave and dual-concentric controls permit separate channel adjustment. It is intended to be connected between preamp and main amplifier and insertion loss is given as 2 dB. Harmonic distortion is less than 0.3%. The price is \$179.95.



RCA's new "Audio Center" above, features both FM and AM reception plus the audio portion of VHF and UHF television programs. An unusual feature is the provision of raised braille characters on the controls to assist the visually handicapped. List price is \$79.95 and it will be available in September.



Harmon-Kardon CAD5 professional tape cassette deck with Dolby system.

# connections for stereo

The Crossover connected to the Power Amp



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# Classical Record Reviews

EDWARD TATNALL CANBY



## Kipnis I and II

**The Art of Alexander Kipnis, Album 2. Seraphim 60124 mono \$2.98.**

The elder Kipnis, now almost eighty, was the finest basso of the operatic 1930s on records—his career had begun before World War I in Germany and in the period between the wars he came to America as a citizen and became one of the “Met” regulars. It is no exaggeration to say that there has been no such voice since—not that combination of gorgeous bass-baritone sound (he was born Russian) and intelligent, musical understanding. He was superb in opera, in any style that demanded a big bass, but he was equally fine in solo songs, the German *Lied*. Side 1 of this second Kipnis reissue features him in opera—Faust, Don Carlo, and Parsifal—plus a couple of Russian folk songs; side 2 is devoted to Brahms *Lieder*, with that ubiquitous accompanist, Gerald Moore, whose piano recordings are still coming out today.

The recordings are all electric, of that early sort with the closet-like acoustics, the soloist miked ultra-close, the orchestra, or piano, in the background. Enough highs to make the words clear, and a curiously effective kind of recording distortion that seems, if anything, to enhance the complex coloration of the big voice. The brilliance of such a huge basso, after all, is made up of acoustic intermodulations, and a bit of extra IM added by the machinery only intensifies the effect!

A curiosity of a musical nature here: when the great German conductor Karl Muck flatly refused to make the necessary 78-rpm side breaks in the recording of the Parsifal Good Friday Music with Kipnis, Wagner's own son, Siegfried Wagner, took over and it is he who conducts the music on this band.

The Brahms on Side 2 is superbly sung (though we could wish for a more audible Gerald Moore) but the voice is somewhat more distorted and bass-y than in the operatic recordings on side 1.

Performances: A                      Sound: C+

**The Harmonious Blacksmith (A Collection of Harpsichord Encores).** Igor Kipnis. Columbia MS 7326 stereo \$5.98.

**Mozart: Concerto in E Flat, K. 271 (Jeunehomme).** Haydn: **Concerto in D, Op. 21.** Igor Kipnis, harpsichord; London Strings, Marriner. Columbia MS 7253 stereo \$5.98.

The younger Kipnis has moved a world away from the elder. The senior Kipnis sang opera and song from the Romantic 19th century onwards; the younger plays harpsichord from the 18th century back. His new “encore” record features harpsichord favorites and I suppose is the harpsichord equivalent of a pop record—few listeners, however, will know that much about harpsichord repertory! Even “Greensleeves” appears here in a circum-spect Elizabethan setting by the well known Anon. Composers range from Byrd and Bull through Rameau, Couperin, D. Scarlatti, two Bachs, Handel, Mozart, and even Beethoven, with an unlikely Albeniz, an earlier composer, as the most curious. For those who do know harpsichord music the selections will be largely familiar.

The Kipnis style is a curious mixture of the old fashioned and the ultra-up-to-date. Old fashioned in that, like Landowska, he tends towards a great deal of rubato, irregularities of time in the interest of expression. Up-to-date in that his ornaments are profuse and expertly done and in many of the dance-movement repeats he adds the proper extra improvised decorations, beyond the written notes. Sometimes the rubato is (for this ear) a bit too nervous; a steadier pulse would help in many works. But the brilliance is there, in phrasing, registration, and finger dexterity. A lively collection.

What a tremendous Mozart concerto is this relatively early K. 271 in E flat—one of the great works! It is to Igor Kipnis' credit that the thought came to me during his performance on the harpsichord of music that is normally familiar in the piano format. He does a splendid job, for Mozart's music is already highly pianistic though in fact it was played in both ways, on the well developed harpsichord and on the relatively primitive piano of the time.

I was suddenly reminded of a similar transition today in another area, from vacuum tubes to solid state. The analogy

is exact. The piano, as it slowly developed, took over very gradually from the highly perfected harpsichord, the style of music changing at the same time. As solid-state components became more sophisticated they, too, took over gradually from the highly developed vacuum tube, and circuitry changed at the same time towards solid-state values. Mozart's concerto, so to speak, came in the early transistor era when tubes, though rapidly declining, still ruled as the more reliable equipment.

The Haydn concerto was even more certainly a harpsichord piece since Haydn, an older man, turned later to the new piano. But the Haydn style is also very pianistic and not easy to put over in harpsichord terms. Again, Kipnis does an excellent job. The London Strings seem a bit edgy but their musicianship is impeccable.

Performances: B+                      Sound: B

**Grieg: Slatter, Op. 72 (Norwegian Folk Dances).** Vladimir Pleshakov, piano. Orion ORS 6908 stereo \$5.98.

**Folk Fiddling from Sweden.** Bjorn Stabi, Ole Hjorth, violins. Elektra H-72033 stereo \$2.98.

Though there are endless provincial differences between the folk dances of the various Scandinavian regions, for an outside ear there is a remarkable family resemblance—between the Norwegian and Swedish, and even between the original fiddle music and the somewhat elaborate piano arrangements of Edvard Grieg, done at the turn of the century. Two minutes' listening to these two disks proves the point.

In Norway this type of fiddle music is played on the special Hardanger fiddle, an instrument with sympathetic tuned strings to reinforce the sound of the played strings, somewhat as in the old viola d'amore. In Sweden, apparently, the fiddlers use plain old fashioned fiddles. As for Grieg, he transfers a surprisingly accurate fiddle sound to the piano including the characteristic drone harmonies and the somewhat odd dissonances and “modal” scale tones that are such a pleasant feature of the original music.

How “classical” it sounds! Somehow, we are vaguely reminded of the Swiss and Austrian folk music, the yodel tunes, the squarely harmonized diatonic dance melodies, and we may reflect that, after all, European “classical” music was built very largely out of—or alongside of—European folk music. Folk music, more traditional, lags technically behind; we are here back in the 18th century in terms of “classical” harmonies. Very pure sound,



to modern ears, and thus the settings by Grieg, relatively recent, sound surprisingly modern.

The pair of young Swedish fiddlers made their recording at the 1969 Newport Folk Festival. The Grieg piano works are played by an excellent U.S. pianist, of Russian ancestry, born in Shanghai. Typical international mix! For comparison, you will find recordings of Norwegian Hardanger fiddle music at most folk music dealers.

*Performances:* A-      *Sound:* B+

**The Fabulous Osipov Balalaika Orchestra.**  
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To be sure, Angel avoids the word "folk" in the title of this recording, though the orchestra's official title is The Nicolai Osipov State Russian Folk Instrument Orchestra. But most listeners will detect a folkish emphasis. If so, it is strictly of the Russian sort. Balalaikas—yes. And folk-style dress-up costumes for the eye. But also a large symphony orchestra; our nearest equivalent might be a moving picture orchestra, the kind with a few banjos and guitars thrown in for local color. The music, accordingly, is very fixed-up, in elaborate arrangements, totally professional in calibre and about as genuinely folk-like as—well, Mantovani. Among the various Russian composers you will find Rachmaninoff. And Rimsky Korsakov. Flight of the Bumble Bee—what else?

*Performances:* Very Pro      *Sound:* B

**Seiji Ozawa Chicago Symphony Rimsky-Korsakov Scheherazade Borodin Polovtsian Dances.** Angel SFO 36034 stereo \$5.98.

Big fuss over the conductor, here, the man who wears his hair long and thick and his clothes extra-mod. Fancy gate-fold get-up, complete with pix of the recording sessions and running comment on same. A hi fi spectacular, I guess, and the hero is Ozawa. A while back this would have been one of Capitol's super-classic deals; now it carries the Angel label though a U.S. product.

A disciplined, no-nonsense performance of the Rimsky war horse music without a trace of excess emotion, accurate in every detail, very much today. I found it slightly chilly, in spite of the heat in Chi the day it was made (as per the program notes). But would more warmth help? Probably not. The music would merely sound sentimental to our jaundiced present-day ears.

I'd say that this is about what you can do with Rimsky at our stage in history—and Borodin as well. We aren't able to listen to the music as it was heard in its own day. Not any more.

Recording? Huge, arena-type sound out of a Shriner temple in Chicago. In spite of twelve mikes, the stereo isn't very spectacular and, indeed, not violently different from mono. Excess reverb confuses its directionality. But the orchestra is miked with excellent balance, the

various solo instruments, notably the solo violin, precisely placed against the overall ensemble, standing out just enough to register yet never too close or too loud. Good. In the Borodin the woodwinds seem to have been specially emphasized. Pleasant enough. Lots of thumping bass for those who love it.

*Performance:* B+

*Sound:* B+

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# Canby the D.J. & Canby at Carnegie Hall

In recent weeks I have been the quite willing victim of two interesting publicity stunts involving recorded music, both of a pop sort though technically I am a classical man. One stunt plugged a pop singer, out of RCA's stable. The other plugged microphones—the Electro-Voice mikes that took down a 16-track tape of a pop percussion band in Carnegie Hall. All this, of course, in the day's work for a classical man in these times; publicity takes it for granted that we know all about pop too. (Some of us do, after a fashion, and more's the pleasure, I assure you.) Or maybe it's just that publicity can't be bothered with petty distinctions, like pop vs. classical.

Neither outfit knows—until now—how gorgeously its stunt misfired in my case. Not that I imply any lack of success elsewhere for either venture. It's just that they picked the wrong guy when they picked me. I really had to laugh. I had a wonderful time.

First, through the mail, RCA sent me a big publicity kit. It was designed to help me promote pop singer José Feliciano, in case I needed help. Now it happens that I knew Mr. Feliciano's work already, unofficially (remember, I'm classical); but it wasn't his excellent music that intrigued me in this case. It was the kit itself.

Most ingenious. It contained two 45 records. One was the expected excerpts from his latest LP, "Alive Alive-O." The other was entitled "FELICIANO: IN PERSON," a special disk designed for disk jockeys. Like me, I supposed. (Don't I run a classical D.J. program in prime New York classical time—Sundays at one?) This one I had to hear.

So, after fumbling around for a half hour trying to find a center-hole insert in order to play the thing on my high-brow LP equipment, I found one, slid the disk onto the table, shifted gears to 45; and out came a Feliciano interview. In person, all right. Both sides, extended play.

Now there's nothing unusual about a recorded interview, but this one was special. A one-voice interview, if you can imagine it. That is, there were Feliciano's answers, one after another, but no questions. They had been edited out, and were printed up on a script, so that you,

Mr. Disk Jockey, can ask them yourself, in your very own voice, as though they were your questions. Neat gimmick! The listeners think you have the Great Man right in the studio with you.

Pretty good if you live in Podunk, or maybe Poughkeepsie. You throw it at him, he answers right back. If, of course, you can manipulate the 45 record successfully. You have to hold it with your finger while you ask each question. Or else you tape-edit, though that takes longer. Either way, if all goes well, you have yourself a cosy little private session with this engaging pop singer, just like real. Only it isn't real.

RCA made one little mistake in my case. A whopper. *They forgot to include the script.*

So there I was with all the answers—and no questions! What to do! You can guess how quickly my beady little eyes lit up when I discovered this. By golly, I'd make up my own questions, and broadcast them too. And so I did. Took Mr. Feliciano (recorded) right into my studio and made him answer a whole series of sober thoughts concerning classical music and its relation to pop music, right off his own interview record. Little did he know! He wasn't even there. It worked like a charm, though!

*Me:* Mr. Feliciano—now this is a classical program—do you find any special difficulties in doing this sort of classical interview?

*F:* Well, uh, there's really not that much difficulty; I guess the only difficulty is, uh, that you know you're being recorded and you sort of strive to be as near perfect as possible. But then again, I'm always trying to do that anyway . . .

*Me:* I suppose you're used to running into people who love classical music and also like what we highbrows call pop.—People sort of like both kinds nowadays, more often than not. And so I should think most of the young classical listeners, at least, would react very favorably to your sort of music.

*F:* Well, I must say that the . . . that they react . . . er, oh, they react very enthusiastically, y'know. But, uh, I think an audience gets as excited as the artist in . . . er, if you create that excitement.

—And so it went, on into some rather serious discussion of the ways in which



classical music of the past has resembled pop music of the present. Schubert vs. Ray Charles. Singing with your heart on your sleeve. Picking up influences via the ear—Mozart, perhaps. Or Leadbelly. Interesting, if I do say so. And completely fake from beginning to end.

It's a clever idea, this "open-end" interview, with only the answers recorded and the questions for any old interviewer who comes along. Not really illegitimate, since the medium does allow it and the results are convincing. But, since one must set up ethical limits somewhere, I do think that RCA is off-base in one respect, along with others who may be trying this same sort of technical stunt. Truth should be told; the interviewee is *not* in the studio, as it seems. Just a happy illusion.

Instead, RCA suggests (and I quote) that "you promote this interview as 'pre-recorded especially for this program'. This is exactly no more or no less than the fact of the matter."

Not fair, RCA. That is a species of weaseling, if you ask me. Using an excellent stunt and a good media trick for less than a candid implication. The fact is that the interviewee was not talking to the D.J., who was sitting there all by himself, with this record.

At least nobody can sit on *me* for being less than straightforward. At the end of my fake interview I explained the whole thing in detail, and even stopped the record in the middle of a word, thereby throttling poor José Feliciano, just to prove the point. It wasn't his fault, remember.

As for those E-V microphones, I got a hurry call from the editor one afternoon to say that this recording session on a 16-track Ampex was coming off in Carnegie Hall that evening and would I attend? Of course! Anybody who schedules a 16-track recording session in Carnegie Hall has all my attention and respect; so I rushed right up. Cocktails 7 to 8, recording session at eight, he told me.

Well, there were a few souls in the Carnegie bar and I had a bit of good cheer, but the show turned out to be a public concert, complete with audience, and I found myself spang in that famed Best Seat in the Concert Hall, right in the middle of the floor about eleven rows from the stage. Ten-dollar seats! Yep, up on the stage I could dimly discern a number of mikes, in and around the most enormous battery of shiny percussion instruments I have ever laid eyes upon—rows of huge marimbas, xylophones, vibraphones, superduperphones, and other machines too complex to name. Presently there was a spate of speech making and

then the young man who was being given his Big Chance came forward to conduct. He had grayish sideburns and weighed in at an easy 200 pounds, but he jiggled in the best big-band tradition as the massive percussion machinery got itself going. Nary a word, however, about Electro-Voice. And I found myself forgetting to watch those mikes.

I never did get any closer to them—how could I?—and I know nothing of what they took down, except certain music that I did not hear at all, though I could see it being played. The P.A. system evidently gave us only part of the sixteen tracks being recorded. People would whang away at drums or metallophones and nothing would emerge. Not into Carnegie, though surely every note was being captured on one of those fabulous tracks, somewhere backstage in the Ampex room. Not a sound. So how could I judge the mikes?

What soon began to fascinate me (and draw my wandering attention still further from E-V) was a pair of incredible percussionists who visibly occupied vast areas of the foreground on the cluttered stage, dashing about like madmen from one instrument to another, holding long sheets of floppy music in front of them as they ran headlong back and forth for a swipe here and a bang there. One of the men

had me hypnotized. He was short, dynamic, fierce, with a furious round beard out in front and huge black spectacles like a psychiatrist. He would scowl a dreadful scowl, then turn and run like a rabbit, dodging a dozen instruments (and mikes) to give a mighty swipe at a bass drum far left—then race, head down, all the way to stage right, grab a pair of hammers and buzz away on a xylophone so fast that his arms would blur; then off again fifty feet for three notes on something else, music always held out at arm's length ahead of him. Incredible! I waited, breathless, to see him make a mistake, or run straight into a kettledrum and knock it over with a crash. But he never missed a beat. It was uncanny. What a bit for television! That man must have covered a couple of miles of stage at top speed before he quit, and played at least a million notes in a dozen different places. A genius . . .

As for E-V, by the time this gets in print we will have located another program book—I lost mine, as usual, on the way out—and can let you know *which* E-V mikes were in use, and what record resulted from the 16-track recording. Natch, what I heard had no relation at all to the finished result. That's what 16-track is all about, isn't it? But I had an awfully good time, just watching. **Æ**

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## New Quadraphonic System

Continued from page 26

Figure 4 indicates how, with proper phasing and mixing of various signal components, the program engineer controls the direction of the sound source. It is always possible to eliminate a specific signal from *one* of the loudspeakers. For example, a front signal will not appear at the rear or a left signal will not appear on the right. Such elimination will make that particular signal appear in the other three speakers, and will produce an apparent source on the side of the room which has the center one of these speakers. For example, all information which is mixed out of phase in identical amplitude will appear to be in the rear loudspeaker, Fig. 4D. Sounds which are desired to come from the front of the listening area should be introduced into both channels in phase, Fig. 4B. The directional patterns of Fig. 4 can all operate simultaneously with different signals in each direction as desired. One group of instruments can appear at the front with different ones at back and sides without interaction between them.

Further if we consider a sound at the front of the hall which arrives some milliseconds later at the rear of the hall, that same millisecond delay will be reproduced in this system. After the sound appears at the front loudspeaker, it will follow at the rear speaker with precisely the same delay in the playback system as in the recording area. Therefore, even though the listener is in a smaller room than in which the recording was made, the time delay from front to rear will be the same as in the large hall, thus reproducing the ambient qualities of that hall.

### Compatibility

This system is completely compatible with normal two-channel stereophonic reproduction. The  $L+F+B$  and  $R+F-B$  signals can be played back on normal two-channel systems without disadvant-

ages and without loss of quality. Records and radio broadcasts using this system can be played normally on systems with conventional two-channel stereophonic equipment. Those who want to hook up the additional speakers can get the benefit of front-to-rear differentiation of sounds as well as the normal side-to-side localization that two channels produce. Normal two-channel material, that is that which is not recorded using this system but recorded in conventional stereophonic fashion, can be played very readily on this system.

If monophonic program material is played using the configuration of Fig. 3, the apparent sound source is primarily in the front loudspeaker. There is no sound output from the rear speaker. In fact, the system balance can be established accurately by adjustment for a null in the back speaker with a monophonic source.

However, when conventional two-channel stereo material is played through the configuration of Fig. 3, the front and side speakers give the same sound as any system with derived center channel; but the rear loudspeaker makes an interesting contribution to the quality of the sound. The rear loudspeaker reproduces the difference information of the two channels. This represents all the direct stereo information *plus* the effects of all reflections and reverberation. These effects are normally masked by the direct sound. This mask is removed when using the rear speaker, and the resulting sound has an open, spacious quality which is a far more accurate representation of the original recording area.

For those who wish to experiment with this effect, it is simple to connect a rear loudspeaker from left "high" output to the right "high" output of the amplifier. If the level is too high, a series resistor can be added. Preferably this speaker should be placed as far behind the listener as possible so there is some delay in hear-

ing of the rear sound. The delay will augment the beneficial effects. In a room where it is not possible to put the speaker to the rear, two such speakers (in series or in parallel depending on the level desired) can be placed at the sides of the listener, and these use the difference information as if they were one speaker. This utilization of a rear speaker is independent of the use of a front loudspeaker, and can be tried without any other changes in the conventional stereo system.

*The use of this one extra loudspeaker can produce as important an effect as the difference between stereophonic and monophonic sound.* However, the benefits are somewhat variable since it is dependent on the random effects of recording techniques which were not concerned with control of ambience. When the recording engineer *deliberately* introduces ambient information, oppositely phased, in the two channels, then a significant improvement in sound reproduction is obtained. A true extra dimension of spaciousness is obtained, and except for the cost of the loudspeakers, it is obtained at no cost.

Another novel and important effect has been observed in testing this system and analyzing its compatibility for various uses. With headphone listening, the left and right directional information appears to the sides. The front (in phase) information appears (as in general headphone listening) at the forehead or top of the head. However, the back (out of phase) information appears at the back of the head. It is providential that this system gives some degree of differentiation between front and rear as this opens the opportunity to produce four discrete directions of sound with two ear pieces. Since the discrimination between front and back involves amplitude and phase changes from ear to ear which depend on the shape of head and contour and absorption characteristics of ear passages, corrective networks can be designed to modify the two channels so that the existing front-to-back discrimination of

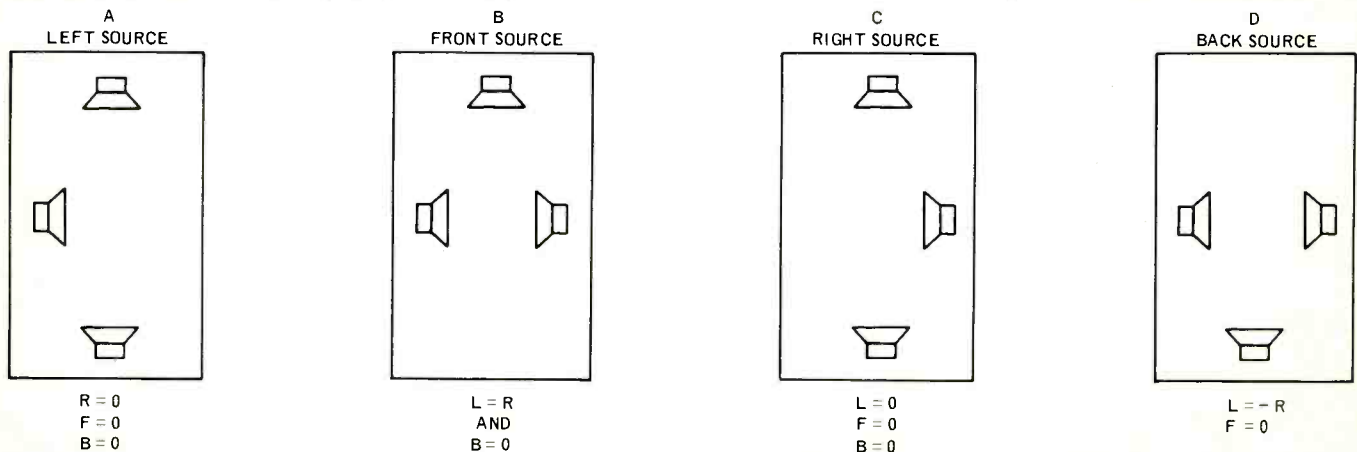


Fig. 4—Program control can eliminate one loudspeaker so as to create an apparent sound source with desired directionality.



the system with headphones can be expanded to full localization of the direction of sound sources.

Thus it can be seen that there is complete bi-lateral compatibility of monophonic equipment, normal two-channel systems, and this multichannel method. The person who connects up this multichannel hookup can play any type of source material, getting full benefit of the enhanced channel information without need of additional amplifiers, and without need for changing or reconnecting his audio system.

The recording engineer can make his recordings on the assumption that people will be using this new system, and he can blend in desired proportions from the different microphones in order to obtain the type of effect which he feels will be most desirable for the listener. It is probable that with classical music of conventional type, most of the recordings will be made to increase the hall ambience effects. With rock music and other popular forms, it is very likely that the sonic effect desired will be of the listener in the center of the group. With synthesized music derived by electronic techniques, it will be possible to have the sound jumping around from speaker to speaker and surrounding the listener with any type of effect which the composer desires.

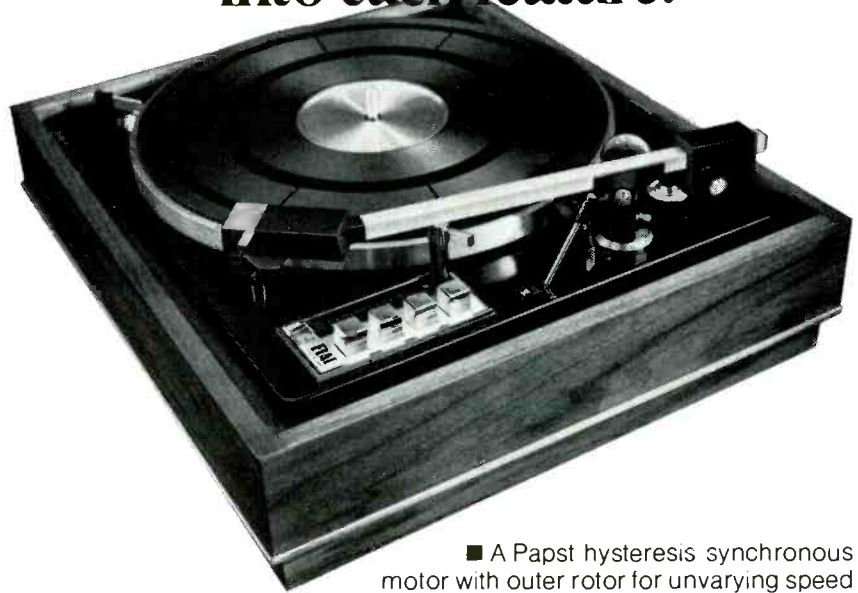
### A Proposal

It is proposed that recording companies start to use this technique for commercial recordings. This can be done not only with new recordings, but many multiple-channel recordings can be re-mixed and re-mastered to give the benefits of this system. Since the recordings will be compatible, there will be no detriment to issuing them with the additional information included. The user will have his own option as to whether to extract the additional dimensional information.

Should commercial recordings be prepared this way, it is completely within present technical capabilities to use some form of compression and/or expansion to augment the directional differences for those rare situations when enhanced directional discrimination is desired. Thus, the proposed system (which has been tested and demonstrated) provides a compatible framework for more sophisticated techniques should they ever be desired. **AE**

The Hafler system will be demonstrated at the Consumer Electronic Show—which, incidentally, is for dealers only. Work is going on behind the scenes with several other systems (Dorren, Quart, etc.) and we will publish full details as they become available. (Ed).

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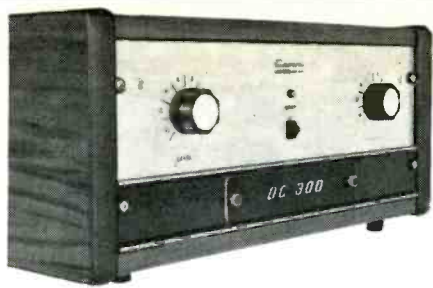
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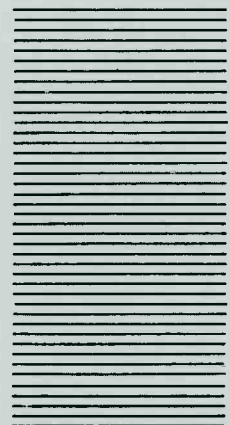
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